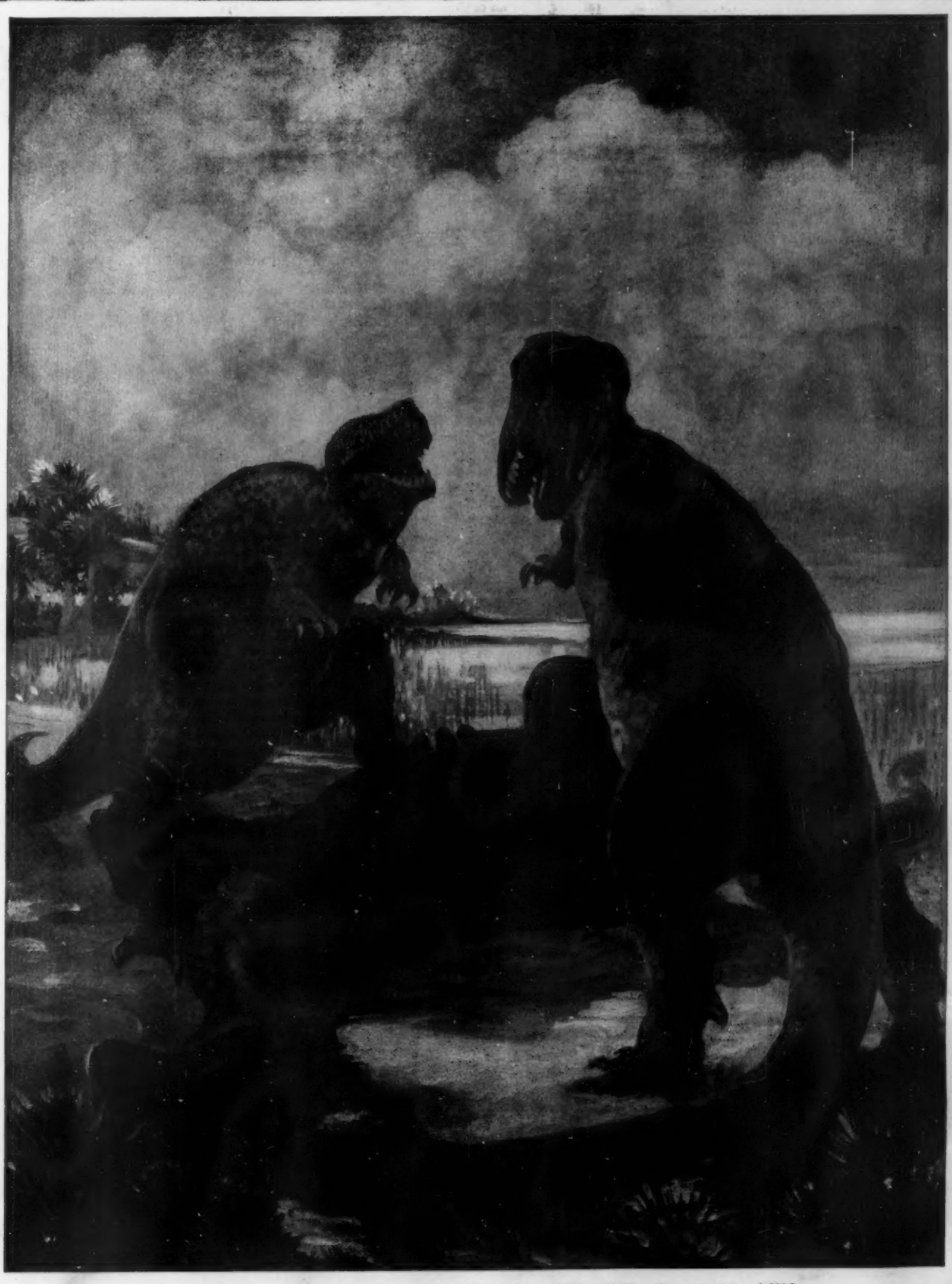
Cylindrical boat

SCIENTIFIC AMERICAN



TYRANNOSAURUS, THE LARGEST FLESH-EATER THAT EVER LIVED.—[See pages 322 and 323.]

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

That "Baby" Submarine

THE outstanding fact in the recent overelaborated newspaper discussion of the so-called "Baby" submarine (or should it more fitly be called the Ford, the Parker or the "Jitney" submarine) is that the average newspaper reporter has a marvelously keen scent in starting up a topic which will hold the public interest for a successive run of issues.

Incidentally, this baby submarine fiasco provides food for serious thought on the part of the gentlemen who have been elected to serve on Mr. Daniels' Inventions Board of the Navy; for this wonder-working little craft, with its obviously and absurdly impossible claims, is a fair sample of much of the material which will be presented for the serious consideration of the board.

Indeed, it was fair to presume that this much-heralded invention was of a class greatly superior to the average that will be offered for the consideration of the Inventions Board. We speak not without knowledge, for we made it a point to ascertain by personal interview with one of the most erudite of the sponsors of this invention just what he expected it to do and the technical grounds on which his high hopes were based. The result establishes once more the wisdom of the old Latin adage:—"Ne sutor ultra crepidam," which being interpreted, reads "Let the cobbler stick to his last," and proves that, because a man is proficient in one field of technical science, his special knowledge will not save him from floundering helplessly when he undertakes to solve the problems in some other broader and more complicated field with which he is quite unfamiliar. For we venture to state, without fear of contradiction, that there is no field of human activity which demands a broader technical knowledge on the part of the inventor than that of naval construction.

As he reads the above, it occurs to the Editor that he is dealing perhaps too much in generalities, so we will at once get down to the facts. We gathered from the inventor that his little submarines, to be built in batches of hundreds (or was it thousands) at a time, is to be very diminutive, is to carry a crew of *two* men (to handle the torpedoes and run the engines, steer the boat, handle the diving rudders, look through the periscopes, plot the course, etc.—pretty fair work for two men), is to have a speed of forty knots, is to receive its enormous air supply for the gas engines and discharge the products of combustion through two vertical pipes 12 inches to 15 inches in diameter, which are to extend above the surface after the manner of a periscope, and that they are, of necessity, to have their tops well clear of waves and wash.

A little questioning proved that the inventor had overlooked the fact that these two large tubes projecting at all times above the surface and rushing through the water at 40 knots speed, would rob the submarine of that very quality of invisibility which renders it so deadly in attack. It had not occurred to him that if such a speed or anything like it were realized, these air and exhaust pipes would throw two broad and lofty arcs of spray into the air, which if the sun were out, would be visible to the naked eye as far as the distant horizon and, even in dull weather, would be picked up long before the submarine came within torpedo range.

Also, the astounding fact was developed that the author of this naval "kill-all" was ignorant of the fact that the resistance of such a vessel at this speed rises as between the cube and the fourth power. He had made no calculations as to the maximum power required, but assumed that because of the small size of this craft, 50 horse-power would suffice to drive it at 10 knots. It was pointed out to him that since the cube of 10 is 1,000 and the cube of 40 is 64,000, if 50 horse-power sufficed for 10 knots, it would take 3,200 horse-power to drive the craft at 40 knots. Great was his dismay when he was told that 3,200 horse-power was nearly six times as much as is required to drive the largest modern submarine at the usual speed of about 10 knots when submerged. Having grasped this fact, it was not difficult to prove to him that to carry the engine power necessary to drive a submarine at 40 knots, his "baby" craft would have to be expanded in displacement until it was a submarine monster rivaling the biggest modern warships in size.

Mr. Ford has described his submarine as provided with a boom carrying "an explosive pellet." If by this he means some species of mine carried by and attached to the submarine, it would be interesting to know what is to become of the "baby" wonder when it has reached and sunk its victim.

And, therefore, we suggest that when the wise inventor essays to take up the extraordinarily complicated problem of submarine construction, he will first subject himself to several months of very careful study, in order to grasp those elementary principles upon which all successful development of the science and art of submarine construction is founded.

Approaching Advent of Commercial Wireless Telephony

THE announcement of the successful wireless telephone tests held on September 29th between the Government wireless station, at Arlington, near Washington, and a temporary installation at Pearl Harbor, Hawaii, a distance of 4,900 miles by air line, has been received by the world of science in general, and wireless men in particular, with the greatest surprise. No more important step has been made in wireless communication during recent years. And the amazement created by the achievement is considerably amplified by the fact that the success is scored by an unknown wireless telephone system which has been secretly developed during the past three years by the engineers of the American Telephone and Telegraph Company.

Aside from the great distances covered, the tests are interesting in that they have demonstrated the possibility of speaking into any Bell telephone instrument and have the conversation transferred to the wireless telephone apparatus situated several hundred miles away. This, obviously, renders the future commercial wireless telephone available to any one having access to the regular telephone service; and it is not impossible that at no distant date a person in his home, using the ordinary telephone instrument, will be able to hold conversation with another person on a steamer in mid-ocean. We have the assurances of John J. Carty, chief engineer of the company and head of the corps of engineers who developed the new wireless telephone, that this will be realized within but few years' time.

The wireless telephone has always toiled under an unlucky star. It never enjoyed that period of infancy in the laboratory that is accorded most inventions—it was exploited long before it approached a state of commercial practicability, and hence resulted in ignominous failure. Little wonder that the possibilities of the wireless telephone have been, and still are to a great extent, regarded with suspicion and derision by the scientific world. But it is fast living down its past unsavory reputation. Slowly, but surely, it has come into its own, now to be crowned by the greatest achievement of all—long distance communication in the presence of the Government officials and as the protege of capable telephone engineers as well as a powerful business organization.

In Defense of Our Feathered Cosmopolites

THE bobolink that nests in New England, winters in Brazil, the night hawk that summers in Alaska spends the winter months in Argentina, 7,000 miles away, while the Arctic tern, whose nests have been found within seven and one-half degrees of the North Pole, migrates over a space of 11,000 miles to the Antarctic lands where he can see the sun night and day during our winter months. The migrating bird knows no national boundaries, still less, does he recognize state boundaries.

This was a matter of little public concern, until the value of birds to mankind was realized. It has been said that the true lords of the universe are the insects. So prolific are they, that despite a constant struggle against myriads of enemies, they continue to thrive and devastate our crops. How powerless we are to check their ravages is only realized when their natural enemy, the bird, is destroyed. It is stated, that if unchecked, the gypsy moth would destroy all the foliage of this country within eight years. Only the voracious appetites of the birds keeps them from overrunning the land. A single bird has been seen to eat thirty-five gypsy moths per minute for eighteen minutes at a time. Six years ago sections of New York and New England were ravaged by the tent caterpillar. The birds came to the rescue and devoured them so rapidly, that, within two years' time, there was not a trace of the devastation to be seen. It was Franklin's gull that saved the early settlers in Utah from starvation by devouring the crickets that were consuming their crops. Birds are worth millions of dollars to a state, not only in the destruction of insects, but also, in the destruction of vermin and noxious weed seeds. They provide the only adequate means of combating the boll weevil, the gypsy and the brown tailed moth, and similar pests.

Realizing their value, many states have passed laws prohibiting the hunting of birds, except during restricted periods, but these provisions are inadequate in the case of the migratory species which pass over states that furnish the birds no protection, or, where at best, the game laws are very lax. It was for this reason—because certain states appreciated the value of the services rendered by birds—that efforts were made to protect them even outside of their state limits.

By a recent act of Congress migratory birds were placed under Federal control. The law which prohibits the shooting of birds in the spring time, went into force on October 1st, 1913. Spring time is a very important period in the life of the migrating bird, for the reason, that mating usually occurs in the south before starting the journey to the north, and the killing of a single bird at this time may mean the loss of an entire brood. Recently the constitutionality of the act has been questioned. Hon. Jacob Trieber, United States District Judge of the Eastern District of Kansas, has declared the law unconstitutional. An appeal has been taken from this decision, and will now be argued before the Supreme Court. It will be urged that the interests of the people of the United States require such a law; that these birds are really the property of the nation and not of any one state; and (quoting a previous decision regarding the ownership of wild game) that "The genius and character of the whole Government seem to be that its action is to be applied to all the external concerns of the nation, and to those internal concerns which affect the state, generally." Surely the protection of migratory birds affects the states generally.

Earthquake Literature

MOST of us can remember the time when the word *seismology* had not yet made its appearance in the "unabridged" dictionaries. Today the branch of science that bears this name is represented by several societies and special journals and enough treatises and memoirs to constitute a large library. Yet even now the literature of seismology is by no means widely disseminated. It is safe to say that not more than three or four institutions in the United States contain fairly strong collections of such literature.

The number of excellent treatises on earthquakes is impressively large. In English we have the works of Milne, Dutton, Hobbs, Davison, Walker, and Knott. In French there are three admirable works by Montessus de Ballore, together with more popular books by Moreux and others. In German there is a monumental treatise on seismometry by Galitzin (translated from Russian), and the same writer has published a great number of books and memoirs, in German as well as Russian, on special branches of earthquake science. Sieberg's "Erdbebenkunde" is a standard German treatise.

Much fundamental information on this subject emanates from Japan, and this is, for the most part, available in English in the Transactions of the Seismological Society of Japan, the Publications of the Earthquake Investigation Committee in Foreign Languages, and the Bulletin of the Imperial Earthquake Investigation Committee.

Other periodicals devoted to earthquakes include the bulletins of the American and Italian seismological societies, and *Die Erdebebenwarte* (Laibach, Austria). A fund of information is available in the session reports of the International Seismological Association, and also in the annual reports on seismological investigations published for many years past in the reports of the British Association.

In this country the Geological Survey has published special reports on the San Francisco, New Madrid and Yakutat Bay earthquakes. Works on earthquakes in the Philippines have been issued by the Philippine Weather Bureau.

Current earthquake statistics are published on a voluminous scale by the International Seismological Association, as well as by the seismological commissions of the St. Petersburg and Vienna Academies of Sciences, and a large number of meteorological services and observatories.

Electricity

Electric Heat from Arctic Winds.—The mission settlement at Mt. Hope, one hundred miles north of the arctic circle, in Alaska, is contemplating the installation of an electric lighting plant to be driven by large windmills. During the long arctic winter, the steady winds in that region seldom fall below 20 miles per hour, which is ample for driving the power plant. Since fuel of any kind is exceedingly expensive in that region, the power will serve the dual purpose of illumination and heating.

Loud-speaking Telephone Device.—In England there has appeared a new telephone device which renders possible the summoning of a subscriber back to the telephone after he has been asked to "hold the wire" while the party at the other end is looking up some desired information. The device is in reality a loud-speaking horn. If the subscriber called does not wish to hold the receiver to his ear, he can place it over the horn and go about his duties. The calling party's voice is so amplified that he may be heard throughout a room.

Searchlight for Motion-picture Photography.—In order to take motion pictures at night amid country scenes far removed from electric power lines, a leading American photoplay producer has fitted up a fair-sized power plant on a big motor truck. The portable lighting equipment includes a number of projection lamps which may be connected to the power plant by 2,000-foot cables. This permits the projection lamps to be taken into caves, ravines or other inaccessible places that may be found suitable as backgrounds for the photoplays. A 13-inch navy type searchlight is one of the features of the portable lighting plant. It is so mounted at the side of the driver's seat that its rays of light may be played in any direction. If need be, this searchlight may be employed to illuminate motion picture settings in conjunction with the other lamps. Current for the lamps and searchlight is supplied by a generator which is driven by the motor truck engine. The entire portable plant outfit weighs approximately four tons.

Increasing the Efficiency of Leclanché Cells.—Experiments recently conducted by Ernest G. Crocker of the graduating class in electro-chemistry at the Massachusetts Institute of Technology with the chemical reaction in the Leclanché type of primary cell have disclosed several points of commercial value. Contrary to the existing belief that the polarization in such a cell is the result of a film of hydrogen surrounding the carbon element, it has been found that the alkaline action of ammonia is responsible for this condition. Tests were conducted with different sized grains of the materials used in dry cell construction, as well as various proportions of the materials. The most suitable fineness was found to be between one-fortieth and one-hundredth of an inch, while the two constituents should be of the same size. Carbon and pyrolusite are the two materials used, and the quantity of the latter should be about sixty per cent of the bulk of the entire mixture. Chloride of zinc is recommended as the best agent for eliminating the alkaline effects. Although dry cells have been in use for many years, Mr. Crocker states that of all the cells he tested there was none using the materials in the most effective sizes.

Substituting Electricity for Manual Labor at West Point.—Not only is electricity used to illuminate the buildings and streets of the United States Military Academy at West Point, N. Y., but it is also employed for many diversified tasks. For instance, in the kitchen it drives machinery for peeling potatoes, freezing ice cream, cutting meat, washing dishes, pasteurizing milk, chopping ice, washing tableware and grinding knives, and for many other tasks directly or indirectly related to the preparation of food. In the tailor shops two sewing tables of seven machines each, as well as nine individual sewing machines, are operated by electricity. Electric current is used in the laundry for the ironing of linen at the rate of 1,000 pieces per hour. A larger extractor, a marking machine and three glove shapers are also electrically operated. In the bakery the mixing and kneading processes in the preparation of bread and pastry are also accomplished by electricity. Electric elevators are employed in many of the buildings of the Academy.

Solving Mathematical Problems by Electricity.—The possibility of devising an electrical machine for solving numerical equations to any degree has recently been suggested by a French author. Essentially, the machine will consist of a collection of various electromagnetic machines, connected in cascade; the armature circuit of one machine being used in the excitation circuit of the next and so on. It has been demonstrated by a commentator on the suggestion that by the connection of transformers in cascade, it would be possible not only to solve algebraic equations but linear differential equations with constant co-efficients as well.

Astronomy

Mellish's Comet according to a bulletin from Harvard College Observatory, Prof. A. O. Leuschner, director of the Students' Observatory, Berkeley, Cal., gives the following ephemeris of Mellish's comet, computed by Einarssou and Alter from observations on September 18, 20 and 21:

G. M. T.		R. A.	Dec.	Light.
		h. m. s.	° ′	
1915, September	23.5	11 04 50	+24 32	1.24
	27.5	11 37 23	21 54	
October	1.5	12 09 52	18 32	
	5.5	12 41 28	14 26	2.25

A letter from Prof. E. B. Frost states that the comet was first seen by Mr. Mellish on the night of September 13.

The Density of Matter in Interstellar Space is discussed in *Nature* by Prof. Louis Vessot King, of McGill University. Several investigators have adduced evidence to show that the light from distant stars suffers a slight attenuation in traveling through space, and fairly definite numerical values for such attenuation in the case of certain stars of known proper motion and spectral types have recently been obtained. Assuming this loss of light to be the result of scattering by a "residual" gas occupying interstellar space, also assuming this gas to be hydrogen, and applying a method introduced by Larmor for assigning an upper limit to the density of comets' tails, the writer computes the molecular density in interstellar space to be 128,000 hydrogen molecules per cubic centimeter. A sphere of this density having a radius equal to that of Neptune's orbit would have a mass one-thirty-eighth that of the earth. Prof. King thinks that a gas of such tenuity could have no appreciable effect on planetary motions, but might be identified with the slightly resisting medium to which some astronomers have ascribed the secular acceleration of Encke's comet. He also suggests that the scattering of starlight by the interstellar gas might explain the extremely faint luminosity which several observers believe to exist over the background of the sky.

Jupiter's Great Red Spot had an average rotation period during the 84 years, 1831-1914, of 9 hrs. 55 min. 36.9 sec. Its period is not, however, constant. On the planet's south tropical bright zone there is a mass of dark material, first noticed in 1901, which moves faster than the red spot, its period of rotation being about 17 seconds shorter than the average period of the spot. Situated in about the same latitude as the red spot, this dark mass overtakes and passes the latter from time to time, and when this occurs the motion of the spot is temporarily accelerated; an effect first pointed out by M. Eugene Antoniadi. Apart from these recurrent small fluctuations in speed, there have been larger irregular fluctuations, which are fully described in a recent paper by W. F. Denning. Up to the middle of 1914 the motion of the red spot had been greatly accelerated since 1901, and especially since 1910. Between 1901 and 1914 the rotation period of the spot decreased by 8 seconds. Within the past year, however, the velocity of the spot has decidedly slackened.

The Blink Method of Detecting the Proper Motions of Stars as recorded on photographic plates, devised by Dr. Pulfrich, of Jena, was well described by Mr. R. T. A. Innes in a recent address, published in *Nature* of August 26. Given two plates of the same region of the sky, taken at an interval of some years, it is possible by this method to pick out with remarkable rapidity those that have changed their relative positions in the interval. The plates are placed side by side, like pictures in a stereoscope, and are examined with one eye through an optical and mechanical arrangement that lets the eye rest first on one plate and then the other, the alternation occurring three or four times in a second. This "blinking" makes the eye so remarkably sensitive to differences in the positions of stars on the two plates that a shift of a hundredth of a millimetre is, says Mr. Innes, "not only unmistakable, it is obtrusive." It is easier to deal with 1,000 stars by this method than with one by the older methods.

Canopus.—This giant of the stellar system is, according to a recent calculation of W. F. A. Ellison, 49,000 times as bright as the sun. It is 134 times as large as the sun in diameter, 18,000 times in surface, and 2,420,000 times in volume. Its distance from us, according to the same estimate, is 489 light years. Suppose, says Mr. Ellison, that instead of being at this enormous distance it were placed in the center of the solar system, in lieu of the sun. It would then occupy eighty-five hundredths of the space lying within the orbit of Venus, and as seen from the earth, would subtend an angle of about 70 degrees of arc. Thus, when its lower limb was on our horizon, its upper would be within 20 degrees of the zenith. Needless to say, no life could exist on earth with such a neighbor.

Automobile Notes

Germany Makes New Benzol Rules.—In order to prevent the accumulation of benzol, or the manipulation of this product by the manufacturer so as to boost the price, the German government has issued a command, forbidding the manufacturing of benzol to all persons in the Empire, with the following exceptions: Chemical factories, engaged in the making of explosives or chemicals for the government; and chemical factories which agree to turn over the entire amount of toluol produced during the manufacture of benzol to the government. To make this latter order effective, every gallon of benzol offered to the German public for automobile use must be completely freed from toluol. If even a small quantity of toluol is contained in the benzol sold by the manufacturer, the latter is severely punished. The maximum amount of toluol permissible in benzol has been fixed at 1 per cent, the government realizing that in the course of forced production small quantities are liable to become mixed with the benzol.

Novel Automatic Gear Change.—One of the latest British inventions consists of a new type of automatic gear change for automobiles. Generally speaking, the speed gear comprises a straight-through gear box, operated by a central spindle. The spindle is connected to a spring-controlled sliding member which in its turn is adjusted longitudinally by the centrifugal governor above it. When starting the car the gear lever is shifted from neutral into either the first forward, or reverse positions. After the driven shaft has reached a certain speed, the centrifugal governor automatically brings the next gear into action; when the speed has again increased, the highest speed ratio is engaged similarly. Retarding the speed of the car causes the reverse series of operations to take place.

Germany Fights Glass Throwing.—The acknowledged scarcity of rubber and rubber products in Germany at the present time has resulted in a new order of the German government, issued through the medium of its school teachers. Every teacher has been instructed to tell his pupils to look carefully over the roadways which they have to pass, and to pick up every bit of broken glass, or sharp pieces of metal, which might be injurious to automobiles. The importance of the automobile in the war operations has been put before the school children in so graphic a manner that they are enthusiastic over the prospect of being able to help its efficiency. Grown-ups who are seen to drop glass or bottles upon the highways, are subjected to severe reprimand on the first occasion and to a fine on the second. Motorists who in former years have been suffering from the broken glass and sharp tacks on roads and streets, declare that the order has cleaned the roads as if by magic, and that punctures or blow-outs are a rare occasion at present.

Keeps Windshield Clear With Heat.—There have been a number of mechanical devices designed to keep the windshield of a motor car clear in a driving rain, but most of them rely on either mechanical wiping off, or on coating the glass surface with a chemical preparation which sheds the water. An entirely different idea is embodied in the new "electric" windshield cleaner, which has just appeared on the market. This device consists of a coil of resistance wire in an oval frame, hung close to the glass directly in front of the driver's face. The electric current generated by the starting and lighting dynamo, or the ignition system, is passed through the resistance coil and heats it. The heat is communicated to the oval space of the windshield, so that water falling on this spot is dried up.

30,000 British War Truck Drivers.—By a slip of the censor it has become known that at present 30,000 drivers are in active service at the British front, driving motor trucks carrying supplies and ammunition. This number does not include hospital corps, ambulances, armored cars, etc., but simply supplies transport service. The information was contained in an official communication from Maj.-Gen. S. S. Long, director-in-chief of the British Supplies and Transport Service, to the British journal *The Commercial Motor*. The men receive six shillings a day, for the skilled veterans, and one and one-half shillings a day for the novices.

Glass-Roofed Limousines.—The material "cellon," described in these columns several months ago as an excellent substitute for glass, is now being extensively used in German limousines as roof material. The entire roof, as well as large windows on the sides and rear, consist of this remarkable substance, and attempts are now being made to construct American limousines on a similar plan. As cellon cannot be exported from Germany at present and an all-glass roof is too dangerous, it is suggested to use the so-called "triplex" glass for this purpose. This glass does not splinter even if struck with a hammer, and therefore does not endanger the passengers. A limousine with glass roof is expected among the novelties at the New York automobile show.

"Repairing the Gulflight"

Damage Done by the Torpedo and How It Was Repaired

THE skill that has been attained by modern shipbuilders in the repairing of extensively damaged vessels is evinced in the remarkable case of the "Gulflight," an American steamer that was torpedoed by a German submarine last May, resulting in a huge hole and several minor ones being torn in the vessel's hull. Since the time of the attack the steamer has been repaired in a British shipyard and, upon her recent return to the home port, has again entered active service, none the worse from the torpedo attack.

The "Gulflight" sailed from Port Arthur, Texas, on April 10th of this year, bound for Rouen, France, with a full cargo amounting to 50,000 barrels of gasoline. On May 1st, when the steamer was off the Scilly Islands, the second officer sighted a submarine traveling at right angles to the course of the American vessel. After remaining in sight for about five minutes, the submarine was submerged right ahead of the "Gulflight." A few minutes later the steamer was violently jarred by a terrific explosion on the starboard bow, which hurled vast quantities of water high in the air. The shock of the explosion resulted in the death of Captain Gunter, due to heart failure, as well as that of the wireless operator, Charles S. Short, who was drowned.

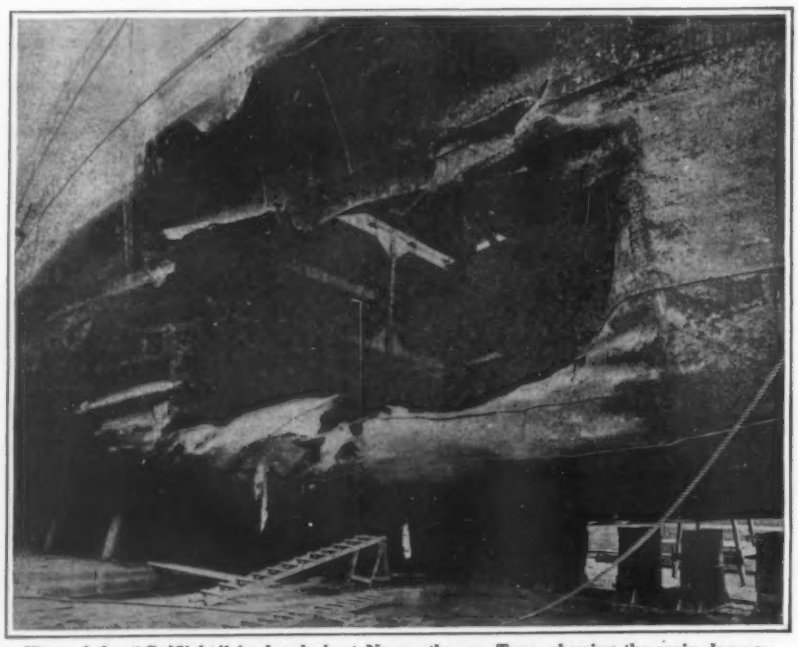
After the survivors had lowered the boats and subsequently been picked up by patrol vessels, the "Gulflight" was towed into a port on Scilly, where part of her cargo was discharged into lighters. The vessel, then riding higher in the water, proceeded to her original destination where the balance of the cargo was discharged. The "Gulflight" then made for Newcastle-on-Tyne, where she was placed on dry dock and repaired.

The damage sustained by the "Gulflight" consisted, in the main, of a huge, ragged hole on one side of the hull and a number of smaller holes; the latter being caused by the flying fragments of metal wrenched out of place and flung through the air, piercing the steel plates on the other side. The nature of the holes was such that a large section on both sides of the hull had to be removed. At one time during the work the bow portion of the vessel was almost disconnected entirely from the after portion, only a few beams of the skeleton holding them together.

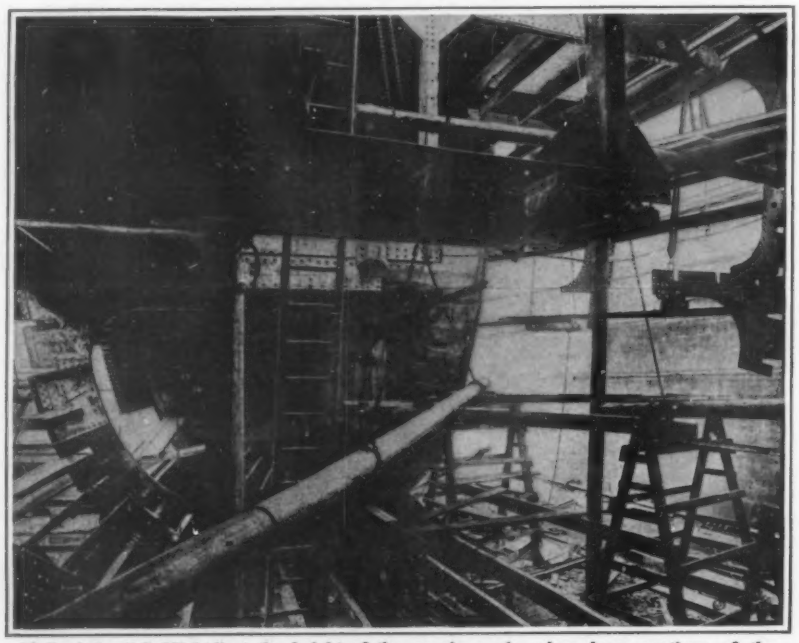
The repairing of the "Gulflight" required several months because of the amount of work involved, but it was finally brought to a successful consummation, and September 12th found the vessel back in her home port—Port Arthur, Texas,—followed by her re-entering regular service between that port and North Atlantic ports. In all, the "Gulflight" was out of commission five months following the torpedo attack.

While the incident will perhaps be longer remembered for its serious effect on the then already strained diplomatic relations between the United States and Germany, still the successful repairing of a frail steamer, shattered by a torpedo capable of destroying the mightiest dreadnought, is none the less noteworthy.

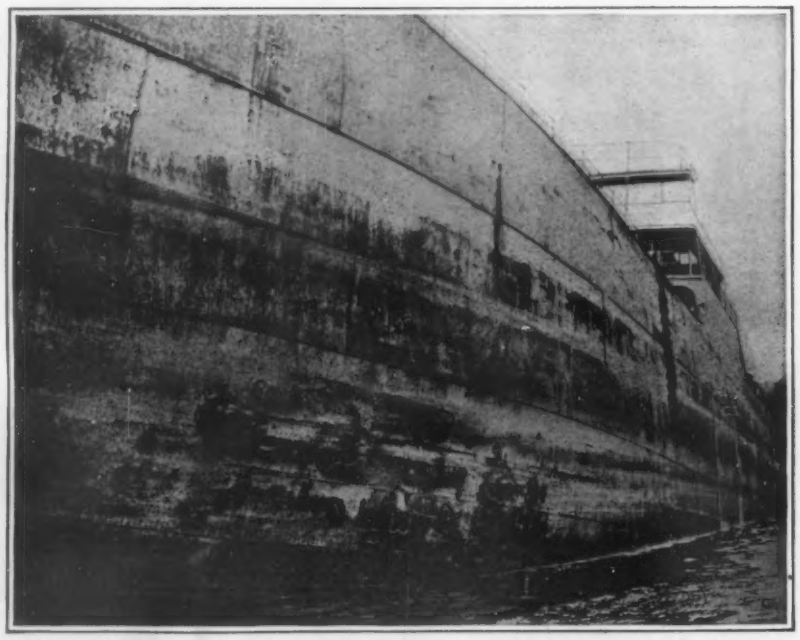
The illustrations give an excellent idea of the extent of the damage done, and the repairs necessary.



View of the "Gulflight" in dry dock at Newcastle-on-Tyne, showing the main damage caused by the German torpedo



Hull of the "Gulflight" at the height of the repair work, when large sections of the steel plates were removed



Side opposite to that struck by the torpedo, showing the holes caused by flying metal fragments

The Current Supplement

THE leading article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2075 [October 9th, 1915], gives an unusually interesting account of the work of the engineering division of a modern army, and sketches the changes and improvements that have occurred in this branch of service. The constant activity of machine guns, and the ever present "sniper" make it an exceedingly dangerous proceeding for a combatant in Europe to expose any portion of his body above a trench or other protection; but it is necessary to make observations and keep a watch on the enemy at all times, and to do this without serious danger science has been invoked, with the periscope as a result. We are mostly familiar with the instrument used by submarine craft, but a variety of similar instruments have been devised for land use, modified in many ways to meet the particular uses to which they are put. An illustrated article in this issue gives some idea of these devices, and shows how they are used. Kiel is one of the great German naval bases, and about it considerable interest now centres. There is an excellent engineering article that describes its important features, and there is a plan of the port, together with two illustrations. The Whale Shark is an immense fish about which but little is known even by naturalists, and the account of its history, accompanied by numerous illustrations, contained in this issue, is of a character to interest both the scientist and the general reader alike. An unusually valuable article of general interest is the paper on Factors of Municipal Engineering. In every city problems of importance to every citizen are multiplying rapidly, and engineering factors are involved in a very large proportion of these questions, therefore, the attitude of the public to the engineer in these matters, and the attitude of the engineer toward the municipality are interesting questions, that are discussed in this paper. In the discussions of preparation for public defense little attention has been given to the medical side of the question, although all records show that this is one of the most important factors in every campaign. Disease and improper attention for the wounded have cost far more lives than bullets, but there is little evidence that any special consideration is being given to this subject, possibly because it is not pleasant to think of. Few people know that there is an act of Congress establishing a medical reserve corps, which might be of inestimable service in case of war; but this act has been systematically ignored, and has resulted in nothing, when it might have been the means of organizing and building up a volunteer service such as the war abroad has demonstrated is necessary in addition to the regular army department. An article in this issue of the Supplement touches on the subject. There is an interesting chart, with a map, showing what was done during the siege of Paris in 1870-71 in utilizing balloons for maintaining communications with the outside world. The illustrated article on signaling on railway trains is concluded, and there is other matter of interest.

Long Distance Wireless Telephony

Distances Achieved in Recent Tests Before Government Officials a Revelation

TO appreciate duly the significance of the recent wireless telephone record of 4,900 miles, one must be familiar with the history of this form of communication.

It is not so many years ago that inventors were struggling with crude appartus, utilizing some form or other of electric arc or high frequency alternator, in an endeavor to converse without wires over distances of but a few miles. The problems facing the wireless telephone inventors were not only numerous, but most difficult to solve as well. Clear articulation of transmitted speech was not easily attained, although musical sounds were conveyed through the air with almost absolute fidelity. Long distance transmission was secured only on the expenditure of considerable power at the transmitter, giving rise to numerous complications due to the inability of existing microphones to handle the heavy current.

It is common knowledge that several inventors have been constantly at work during the past six or more years in experimenting with various types of radio telephones, employing different forms of gaps, arcs and high frequency alternators. From time to time announcements have been made of experiments and tests, in some cases distances of several hundred miles being covered. In one case an inventor succeeded in developing his apparatus to a stage where it could be used commercially, his apparatus in one instance being made in the form of a wall telephone not unlike the conventional wall telephone in common use. However, the distances claimed for this type of instrument, as well as those for other systems, were from a few miles to several hundred miles.

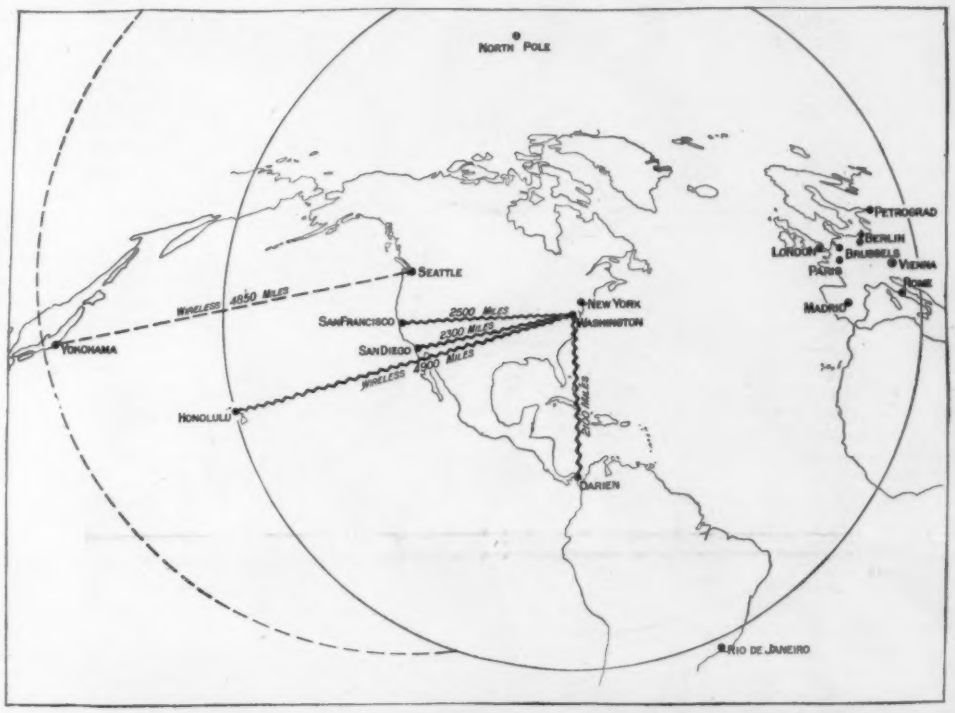
It was, therefore, with the greatest surprise that the scientific world and particularly the wireless men heard of the official tests made by the American Telephone and Telegraph Company on September 29th, when clear, understandable speech was transmitted without the use of wires from the Government wireless station at Arlington, across the Potomac from Washington, to that at the Mare Island Navy Yard, near San Francisco, a distance of 2,500 miles by air line. And still greater was the astonishment when an announcement was made on the following day that the conversation between those two points had been heard by a lone engineer of the company in a frame hut at the foot of a towering mast on the shore of Pearl Harbor, Hawaii, 4,900 miles away from Arlington, the source of the wireless telephone waves.

It is yet too early for the company to disclose any data concerning the type of apparatus employed in the tests. The transmitter was installed in the Government wireless station at Arlington, after permission to use the aerial was granted by the authorities, while receiving sets only were used at the Mare Island station and at Pearl Harbor. The conversation was overheard at several other points within the extreme range of the transmitter, including Darien, Panama. The approximate range of 5,000 miles brought the leading capitals of Europe as far east as Petrograd within the zone of the wireless transmitter. Thus direct wireless telephone communication with different cities of Europe is assured when the European War will have ended and normal conditions are restored between the different countries at war.

Perhaps the most interesting feature of the tests, aside from the stupendous distances covered, is the manner in which the ordinary telephone system and wireless apparatus can be coupled together. Theodore N. Vail, President of the American Telephone and Telegraph Company, speaking into the mouthpiece of an ordinary Bell desk telephone instrument in his office in New York city, caused his voice to travel over the wire to Arlington, where it was transferred to the wireless telephone and sent out in the form of wireless waves to be received by J. J. Carty, Chief Engineer of the Telephone Company, at Mare Island, and others within range and equipped with proper apparatus. It is not impossible that at no distant date communication with ships at sea will be effected by using the ordinary telephone, and that remote places which are now inaccessible will be reached by the wireless telephone, working in conjunction with the ordinary telephone system.

It is said that the system used in the tests is the culmination of several years of painstaking experiments. Early in the spring of this year the system had been developed to a point where good results were secured over a distance of 250 miles, employing for the aerial an experimental tower erected at Montauk Point, L. I., and a small tower in Wilmington, Del. This was shortly followed by tests between Montauk Point and St. Simon's Island, Ga., a distance of 1,000 miles. The engineers to whom credit is due for the success of the system do not lay claim to being inventors. It is admitted that the system is by no means a new, basic invention, but simply the perfection of existing methods; although in the developing of many of the smaller details of the system there have been numerous inventions.

The apparent inauguration of practical wireless telephony gives rise to the question: to what extent will it be employed, as well as what will be its position in regard to the regular telephone system? Thus far the prevailing opinion among telephone and wireless men is that the radio telephone will be a very valuable adjunct to the telephone systems, enabling them to become truly universal in scope. Remote places, such as islands, will be joined by the wireless telephone to the regular systems, and in emergencies the wireless telephones will be available for communication between points when the wire systems fail. To summarize the numerous views on the subject, it is safe to assume that the wireless telephone will find its own niche in the commercial world without altering, but rather increasing, the usefulness of existing telephone systems.



Map indicating the zone covered by the wireless telephone transmitter at Arlington, near Washington

The main circle shows the territory within a radius from Washington of 4,900 miles, the distance from Washington to Pearl Harbor, Hawaii, which was covered by a wireless telephone message on Sept. 29th. The same message could have been heard at any point within the circle. The dotted circle of equal radius shows that a wireless telephone message from a wireless station in the United States could be heard at Yokahoma.

Theodore N. Vail speaking into a telephone instrument at New York for re-transmission by wireless telephone from Arlington, Va., to San Francisco and other points

The officials appearing in this view, from left to right, are: B. Gherardi, engineer of plant; U. N. Bethell, senior vice-president; F. A. Stevenson, general superintendent of plant; Theodore N. Vail, president; K. W. Waterson, engineer of traffic; W. Murray Crane, director; O. B. Blackwell, engineer; John I. Waterbury, director; H. P. Charlesworth, engineer, all of the American Telephone and Telegraph Company, and H. Christopher, special wire man of the New York Telephone Company.

A New Profession for Agricultural Students

The "county agricultural agent" is a well established institution in some parts of the country, but in connection with the vast scheme of agricultural extension work recently inaugurated under the provisions of the Smith-Lever Act, the number of these functionaries is destined to increase at a very rapid rate. There are now about 1,000 of them, and the supply is not equal to the demand for additions to this number. The business of the county agent is to direct the agricultural extension work of a single county, and this work consists in spreading a knowledge of scientific agriculture and home economics among the people; a task that calls for much intelligence, education and personal magnetism on the part of the agent. Here is an opening for students at the agricultural colleges. At present the colleges are not able to supply enough men for these positions.

Strategic Moves of the War, September 28th, 1915

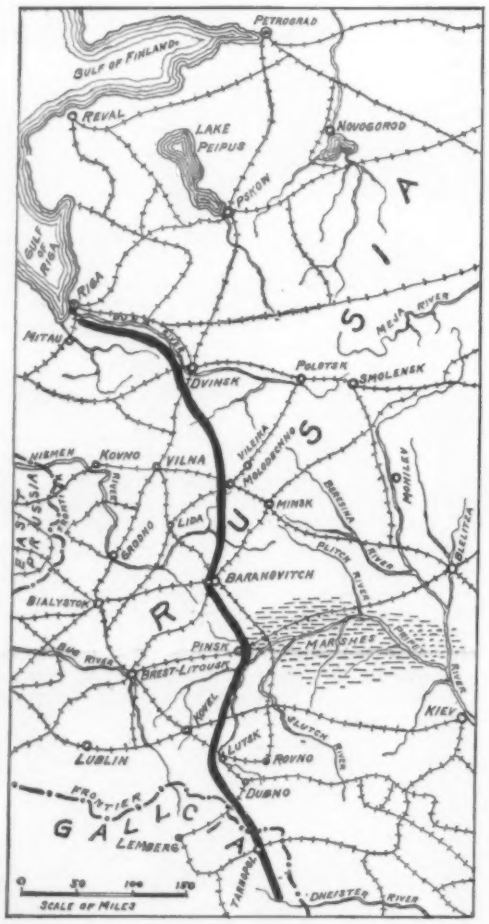
By Capt. Matthew E. Hanna, Recently of the General Staff, U. S. A.

THE week just ended has been one of the most eventful of the war, and later developments may show it to be one of the most decisive, possibly marking a turn in the tide of victory which for five months has flowed so strongly in favor of the Teutons. It has been a week full of surprises, following each other with such rapidity as to leave us almost bewildered. At the outset we were anxiously awaiting the outcome of the German turning movement at Vilna which threatened to capture or destroy a large fraction of the Russian army, when our attention was suddenly diverted from this field by developments in the Balkans. This was surprise number one, to be followed almost immediately by surprise number two, when we learned that the Russian Vilna army had escaped and that the Germans were fighting a furious and apparently successful battle for the possession of Dvinsk and the extreme northern section of the Russian line. For a day or so interest was divided between this struggle and the Balkans, when the greatest surprise of all came with the powerful offensive operations of the Allies in the west from the North Sea to near Verdun. Decidedly, the Allies must be given most, if not all, of the points in this round of the "great fight."

Just how the Russian Vilna army escaped from the Teuton net that swept three quarters of the way around it cannot be determined from the official reports. A week ago there appeared to be slight chance of its escaping except to the southeast towards the marsh land, where its retreat might easily have been turned into a disaster. But the enveloping Teuton line to the east was either weakly held or poorly handled and through it the entire Russian force fought its way to a junction with the balance of the Russian army. The disappointment of the Germans must have been keen. At no time since the beginning of the Russian campaign had their chances been better for capturing a large portion of the Russian army at a place and time which would almost certainly have resulted in the complete separation of the two wings of the Russian line—the prelude to a decisive termination of the war in this theater for many months to come. The final results of this battle, which must have been very expensive to the Germans, was the capture of Vilna and a part of the railroad to the south from that town—acquisitions of no small importance to the Germans, to be sure, but relatively insignificant when compared with the greater prize they failed to capture.

On the southern portion of the battle line in Russia, south of the marsh region, the Russians have continued to gain tactical victories of minor importance which have forced the Austrians to the westward and compelled them to abandon the weak fortress of Lutsk. The Teutons apparently have weakened their forces in this region to strengthen their lines to the north about Vilna and Dvinsk, where they have been making their principal efforts during the week under consideration. It is difficult to see how the Russians can profit permanently by their gains south of the marshes, unless they also succeed in the north. During the week they have lost ground steadily in the region between Vilna and the marsh land and, unless they can stop the Teuton advance on this portion of the front, we may expect to see them withdraw their line south of the marshes to a safer alignment with their forces to the north. No doubt Russia would do this most reluctantly in the face of weaker forces on this part of the line, but she can never overlook the necessity of keeping her vast army intact, and must carefully avoid any strategic move that would give the Germans an opportunity to separate permanently the portions of her army temporarily out of touch with each other because of the Pinsk marshes. Russia probably also is anxious to continue her victorious advance in the south for the additional reason that victory here may help to shape the course Rumania is to take in the final alignment of the Balkan states. Russia and Rumania are supposed to be very friendly, but German influences at Bucharest are so powerful that new Russian reverses near the Rumanian border might turn the balance in the Rumanian government in favor of the Teutons.

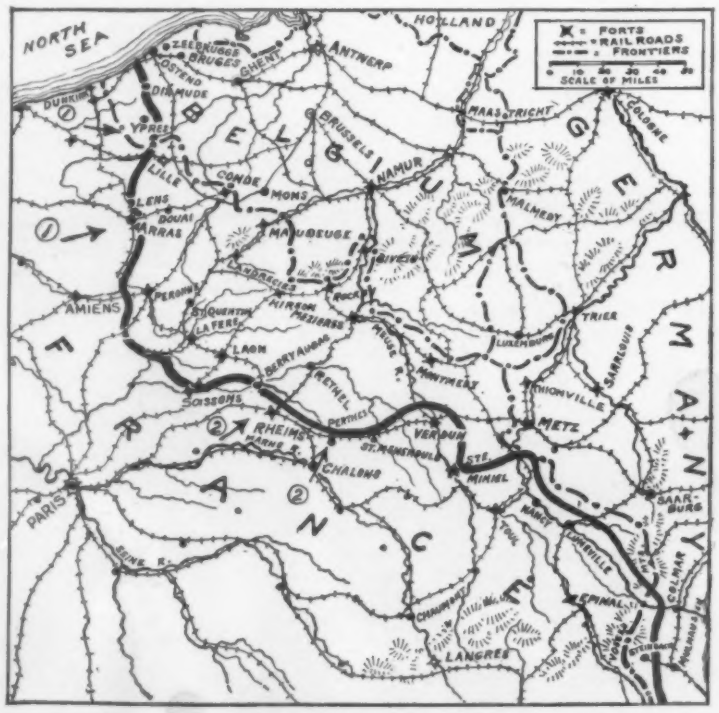
The campaign in Russia for the past ten days illustrates how the victorious advance of a superior enemy on one section of a long line may sometimes be checked most advantageously by increased pressure against that enemy on another part of the front. No doubt one of the main objects of the Russian offensive in the south was to compel the Germans to weaken their forces to the north where they were threatening portions of the Russian army with complete annihilation, but there seems to be little chance of accomplishing this object. The news from this theater since the Grand Duke was relieved of command indicates an effort on the part of the Russians to shift from the defensive to the offensive to a degree that would compel the Germans to play to the Russian lead. North of the marshes they were so inferior in strength to the Teutons, as to make an offensive move quite impossible, but south of the marshes the conditions were more favorable for their effort. But it is no simple matter for an army that has suffered one disastrous defeat after another over a period of five months suddenly to turn on a superior and victorious enemy, wrest the initiative from him, break up his plans, and force him to follow the will of another. Unassisted, Russia could not do this, but the extensive offensive operations of the Allies in France and Belgium may succeed in accomplishing what the minor offensive operations of the Russians on the southern wing of their line have failed to do.



The fighting line in the east

As these notes are written the Germans appear not to have been turned from the task they have set for themselves in the northern portion of the Russian theater. There can be no doubt about the supreme effort the allies are making in every theater, east, west and south, completely to disarrange the Teuton plans in Russia and the Balkans, but so far as outward indications go the Germans are doggedly going ahead with their effort to eliminate the Russian army; or at worst to get possession before cold weather of the favorable line across the Dvina river. The battle along this front, particularly about Dvinsk, the key to the position, has been raging most furiously for many days—and the Germans appear determined to do everything humanly possible in their effort to capture this last Russian stronghold in the northern sector of the coveted line. The Russians also are fighting with a determination they have not shown in months, apparently resolved to hold on to Dvinsk at any cost until the Allied pressure in the west compels the Germans to weaken their armies in the east. The battle about Dvinsk may prove to be one of the bloodiest and most stubbornly contested of the entire war.

At last the storm has broken in the west. After an artillery bombardment lasting for weeks and extending along practically the entire front from the North Sea to Switzerland, the allied infantry began its assault on the morning of September 25th. The principal attacks were made by the British and French to the north and south of Lille and by the French on a 20-mile front in the Champagne region. In both regions the German trenches were practically flattened and made untenable by the terrific two days' bombardment immediately preceding the infantry advance. The assault was made with courage unsurpassed, and in such force as to carry everything before it up to the last line of trenches in the first German position,—a distance of from one to two miles. This occupied the greater part of two days, by which time the Germans had been able to rush reenforcements to the broken portions of their line and had begun violent counter offensives to stem the onrushing tide of English and French. As these notes are written, the Allies appear to be establishing themselves firmly in the captured positions and preparing for a further advance.



Scene of Allies' offensive in the west

[1] Principal British and French attack about Lille. [2] Main French attack in Champagne

Large numbers of prisoners and many guns were captured by the victorious troops, and the French lines have been pushed so far forward that they threaten important transverse railways immediately in rear of the German lines. The power of artillery in preparing the way for an infantry assault has been illustrated more forcibly than in any other battle of the war, and we have seen once more the imperative necessity for weapons such as the hand grenade and short, sharp sword that can be used to greater advantage than the bayonet in the hand to hand fighting. Of very great importance to the Allies in future battles will be the confidence they have gained in their ability to capture, with the support of their artillery, the strongest and best defended trenches the Germans can build.

We have yet to learn whether this assault is an isolated effort of the Allies, precipitated by alarming developments in Russia and the Balkans, or if it is the first step in the long promised offensive in the west that is not to stop until the Germans have been driven from French and Belgian soil or have proven this to be a greater task than the Allies can accomplish. Reports from Berlin indi-

(*Concluded on page* 328.)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Daytime Meteor

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 14th, under the items of "Astronomy," mention is made of "A Brilliant Meteor" observed in the south of England on July 5th of this year shortly after sunset. This interesting item induces the writer to call your attention to the following: In July, 1898, in the city of Scranton, Pa., between the hours of 12 noon and 1 o'clock P.M., as the sun shone brilliantly from a cloudless sky, there appeared in front of the writer, apparently not more than 100 feet away and 50 feet elevated from the earth passing from an easterly to a westerly direction, three balls of candescent light linked together, descending like a bolt of lightning and accompanied with a most terrifying and hissing sound, ending in a report much like the sudden immersion of a large molten mass of iron into a body of water. The phenomenon was directly between the writer and the sun and outshone it by many degrees. The effect upon the writer's eyes was much more serious than to gaze intently at the sun unobscured. Believing it was a meteor that passed, search was made many times for the object or its effect upon the surface of the earth, but all in vain.

Scranton, Pa. C. H. SOPER.

[There is nothing improbable in the suggestion that this object was really a meteor, especially as the weather conditions prevailing at the time seem to preclude the possibility of ball lightning.

From the numerous descriptions of meteoric phenomena given in Chamber's Handbook of Astronomy, 4th ed., vol. 1, the following, referring to an aerolite observed in England, December 13th, 1795, may be selected as presenting features similar to those mentioned by our correspondent: "A loud explosion, followed by a hissing noise, was heard throughout a considerable portion of the surrounding district; a shock was also noticed, as if produced by the falling to the earth of some heavy body. A ploughman saw the stone fall to the ground at a spot not far distant from the place where he was standing," etc.

The fact that Mr. Soper was unable to find any subsequent traces of his meteorite is not surprising, for the reasons that (1) meteors are much smaller bodies than they appear to be when passing in a state of combustion through the air; (2) estimates of altitude and distance under such circumstances are often extremely erroneous; and (3) the meteor may have been completely volatilized before it reached the earth.—Ed.]

Mathematical Coincidences

To the Editor of the SCIENTIFIC AMERICAN:

There seems to be no reason for Alfred J. Lotka's statement (SCIENTIFIC AMERICAN, page 210) "The nearest approach to this (e) expressed as a common fraction using only three figures in numerator and denominator is $\frac{310}{114} = 2.7193$." For:

$$473 \div 174 = 2.71839.$$
$$(e) \quad = 2.71828.$$

There is probably a three-figure ratio still closer.

DONALD M. LIDDELL.

Elizabeth, N. J.

Warship Types of the Future

To the Editor of the SCIENTIFIC AMERICAN:

During the next session of Congress the people of the United States have a right to expect that an adequate provision for the defense of the nation will be made in the light of the stern lessons of the times.

As our chief and, in fact, only defense capable of complete development is admittedly our fleet, it is in this direction that we should expect to see the most energetic measures taken. I have availed myself of your columns to present some observations on salient facts that the limited but important naval action of the European war seems to me to have brought into strong relief.

The great problem confronting every naval power is the attainment of the maximum defensive strength with the minimum expenditure for construction and maintenance of the fleet. Especially does this apply to a power of the democratic and pacific tendencies exhibited by the United States. I am strongly convinced that the great war, by certain logical developments tending to simplification of types, has placed a golden opportunity ready to our grasp, which, if promptly perceived and taken advantage of, will enable us to surmount the obstacle presented to us in our efforts to provide the navy necessary to our interests, namely, the great lead which has been acquired by our potential enemies.

For convenience in discussion, I shall separate these events into three divisions, although in their nature they are interdependent.

First, the supersession of the dreadnought battleship by the battle-cruiser.

Second, the advent of the submarine.

Third, the passing of the surface torpedo boat or destroyer.

Taking up the first point, I wish to protest against the differentiation of first-line ships into these two classes, not because they are not markedly different in powers, but that the distinction is purely technical and quite comparable in effect to the terms torpedo boat and destroyer. In other words, the battle-cruiser is, in fact, a line battleship of advanced design, and the contemporary existence of the two is due to a lack of logic on the part of naval designers. To some extent this statement must be qualified by the admission that it is the complete success of the submarine within its sphere which has given the battle-cruiser the remaining advantage which at one time accrued to the battleship alone, namely, the ability to use its base ports at will.

I do not contend that the battle-cruiser can fight the battleship, so-called, given equal displacements, but that the battle-cruiser, by virtue of its power to accept or decline battle, has simply removed the slow vessel from consideration as a naval arm. This would not be true if the battleship were capable of blockading the battle-cruiser, which, in theory at least, that ship has been able to do. In such an event, the battleship gains in value over the battle-cruiser inevitably, but the advent of the submarine has rendered this operation hazardous, and will, in simple logic, render it impossible in the near future. For the demands on the battleship for excessive offensive and defensive power make it the helpless prey of the submarine of advanced design. By helpless, I mean that it is constantly liable to attack without the contained means to effectively resist.

The circle is therefore complete—the battle-cruiser escapes the battleship; in order to attack the battle-cruiser the battleship must isolate the enemy's bases; in order to isolate, it must in the last analysis blockade; in order to blockade, the battleship must increase its speed to escape the enemy submarines, and by increasing its speed becomes itself a battle-cruiser. Every naval war partakes of this character and may be reduced to these elementary terms, with this all-important exception, that the heavy, slow ship has heretofore been capable of blockading the fast ship. Once more let me emphasize the fact that the submarine has deprived the slow ship of this decisive power, and thus crowned the fast ship king of the ocean. Without the slightest doubt, if the United States were to at once construct twenty, or even ten, battle-cruisers of the most advanced type, with the proper complement of submarines, we would be able to meet the largest fleet in existence unequipped with such vessels and force the naval operations to a point of deadlock, that is to say, in our specific case terminate the conflict victoriously; for it must not be forgotten that, as matters stand, we should be beaten by a superior foe and checkmated, if the term be allowed, by an inferior so provided. I feel sure that this enormous value of the battle-cruiser has been appreciated by the naval authorities of Japan, to a large extent at least, as is demonstrated by the composition of their first line. The Japanese General Staff should be the subject of congratulation on their foresight and good fortune in securing for their country so remarkably a defensive fleet as compared with that of the United States.

However, to make full use of the moment, we must bear in mind Great Britain's well-understood and carefully-applied principle, "Set the pace and keep it." The battle-cruiser sets a premium on speed. Great Britain is building ships of 32 knots. It is my belief that we should at once advance to 40 knots in a displacement of 40,000 to 45,000 tons and provide an armament of ten of the heaviest practicable long-range guns. My figures approach very nearly the limits imposed by the Panama Canal, but our construction cannot be measured by any standard but that set by a possible foe.

This recommendation would be valueless if the submarine were capable of unlimited development, but an examination of the difficulties that circumscribe the submarine designer force the conclusion that no abnormal advance in construction can be expected. Even in the not improbable eventuality that the problem of vision under water is solved, it is difficult to see where the submarine would gain in any direction which could not be taken to better advantage by the less hampered surface boat. As for the immediate present, it is not to be expected that the governments will invest large sums in single ships of so inherently vulnerable a type, unless to obtain great speed. This would require large size, but in that direction we are abruptly confronted by the limited depths of harbors and all that that implies in the case of the submarine. This is, of course, a variable, and we can conceive of flotillas built to operate from bases of exceptional advantage in the respect required, but it is reasonable to consider some thirty-odd feet as the limit in depth for the submarine. This does not admit of excessive displacement for structural reasons, and necessarily concludes the question of speed in favor of the surface boat.

Such being the case, the battle-cruiser must be considered beyond the reach of the submarine, except under special conditions, whose eventuality we may class with the unavoidable fortunes of war.

High speed, however, is not an essential qualification for a submarine. If my conclusions are correct in principle, the present type of fleet submarine proposed for the United States will have reached nearly as high a speed as is necessary. For operations against merchantmen and transports, or for blockade and cruising service, a rate of 20 to at most 30 knots will be adequate to the demands upon it. For general action between fleets, the submarine is doomed to play the part of the Parthian arrow, or, more correctly compared, the ambush. The element of uncertainty injected into a pursuit by the known presence of submarines is strikingly demonstrated by the recent action between battle-cruisers in the North Sea, and points to a valuable, if subordinate, part to be played by the surface craft in future engagements.

But the great outstanding function of the submarine will be its power to prevent close blockade. In more measured definition, it secures a nation's ports to its fleets, to operate from at their leisure, according to their ability. Let me once more strongly emphasize the important bearing this fact has on my conclusions as to the battle-cruiser.

Lastly, I have spoken of the passing of the destroyer. I should rather have stated my proposition in the past tense. For the destroyer is no longer a torpedo boat; it is a small cruiser carrying torpedo tubes. I am convinced that the retention of the destroyer as such in our fleet is more due to the fact that our naval officers are reluctant to abandon an accepted type than to the expectation that the destroyer can be depended on to discharge its hypothetical functions successfully in actual warfare, save under conditions exceptionally favorable, whose occurrence cannot be assumed as a predicated phase of warfare, and therefore does not justify a special type to cope with it. The destroyer does not possess much greater speed than the battle-cruiser.

It is safe to say that under ordinary battle conditions on the high seas the larger vessels can either escape or hunt down the surface torpedo craft; in any event, the presence of small cruisers should render the destroyer ineffective to determine the course of an action. In the event of operations inshore, the submarine is a far more suitable weapon.

It will be noted that the present distressing conflict has discovered the destroyer somewhat unexpectedly engaged in patrol work and as a defense against the submarine.

The unescapable conclusion is that this work would be more efficiently and economically performed by small cruisers with better sea-keeping qualities and greater gun-power.

Great Britain, by placing torpedo tubes on her latest small cruisers, seems to have grasped this principle in part and, in thus approximating the types, approaches in a curious reversed manner the same inevitable conclusion. I feel secure in urging that we frankly relegate to the submarine its proper weapon and, abandoning the destroyer, concentrate our energies on the construction in large numbers of light cruisers well armed and capable of maintaining the high seas for extended periods whether as auxiliary to the battle fleet or on detail duty. Such vessels should, of course, carry tubes as an incidental weapon for general action, or as a *miséricorde* to speedily terminate the existence of a beaten ship.

I am well aware that special conditions might arise in event of war, in which case some of the older types of vessels would be more suitable for the given emergency. But, singular conditions of strategy and tactics apart, it seems to me that the interests of the United States would be best served by the three types to which I have reduced the present system. Certainly these can perform every duty imposed on them in extremity, and it is more economical from every viewpoint to consider such extremities as emergencies to be met with the means in hand than to dissipate the energies of the nation in the multiplication of types which can barely be separated in functions, as is the case in the prevailing system.

For the sake of brevity, I have not cited the incidents of the present war, which bear out the truth of my statements, as I feel that their occurrence is of such recent date and vivid interest that the reader will readily discover their application for himself.

WM. BERGEN CHALFANT.

Pittsburgh, Pa.

Tyrannosaurus, a Cretaceous Carnivorous Dinosaur

The Largest Flesh-Eater That Ever Lived

By Barnum Brown, American Museum of Natural History

RARELY is it safe to speak of anything as ultimate in prehistoric life, but there is little doubt that the American Museum now exhibits a skeleton of the largest flesh-eating animal that has ever lived.

This is *Tyrannosaurus*, the tyrant lizard, a dinosaur that lived during the close of the Cretaceous period. It was one of the very last expressions of its race and, judged by size and structure, was king of its kind. An idea of its immense size can be formed from measurements of the skeleton, 47 feet in length, and, as mounted, 18½ feet in height. When fully erect this animal would have reached a height of 20 feet.

Larger herb-eating dinosaurs have been found in America and East Africa in older rocks of Jurassic or early Cretaceous Age, but the flesh-eaters contemporaneous with them were a third smaller than the present animal.

This skeleton is part of a group that is to be the central figure of the Cretaceous Hall. All of the skeleton material is assembled but there is not sufficient room for the installation of such a large group until a new wing is added to the Museum. The completed group, 54 feet long and 12 feet wide, will comprise three skeletons posed similar to the models to represent a scene of daily occurrence in the dim distant past.

It is early morning along the shore of a Cretaceous lake three millions of years ago. A herbivorous dinosaur *Trachodon* venturing from the water for a breakfast of succulent vegetation has been caught and partly devoured by a giant flesh-eating *Tyrannosaurus*. As this monster crouches over the carcass, busily dismembering it, another *Tyrannosaurus* is attracted to the scene. Approaching, it rises nearly to its full height to grapple the more fortunate hunter and dispute the prey. The crouching figure reluctantly stops eating and accepts the challenge, partly rising to spring on its adversary.

The psychological moment of tense inertia before the combat was chosen to best show positions of the limbs and bodies, as well as to picture an incident in the life history of these giant reptiles. A combat between carnivorous reptiles is strikingly different from that of mammals. Instead of a series of biting and tearing movements, two reptiles spring together, seizing a vital spot, if possible, and hold on till one or the other yields.

Remains of *Tyrannosaurus* are extremely rare and neither of these skeletons were complete. But they supplement each other so that the missing parts of one were cast from the other. Only the lower part of the forearms is modeled from an allied form. Their rarity and huge size give particular interest to the discovery of these skeletons.

Some years ago, while hunting in a wild section of Montana near the Missouri River, Dr. W. T. Hornaday, Director of the Bronx Zoological Garden, discovered several large fossil bones. One of these with a series of photographs of the surrounding "bad lands" was shown to the writer. The fossil was part of a horn of an extinct reptile, *Triceratops*, and the photographs from this new locality showed an area similar to the deposits of Wyoming from which so many Cretaceous fossils have been taken.

It was therefore with sanguine expectations that an expedition was planned for the summer of 1902. Our outfitting point and base of supplies was Miles City, Montana, a point on the railroad nearest to the "bad lands" 130 miles away, and our destination was Jordan, not far from Hell Creek, an association of names that I learned later was not due to any special irreverence on the part of those who christened the places. Jordan was named for its founder, while the creek was doubtless named by some cowboy who failed to get through the surrounding "bad lands."

Five days of travel over boundless, undulating prairie with numerous bands of sheep and fewer herds of cattle brought us to the much-talked-of Jordan, where cowboys still created excitement by "shooting up the town." I was surprised when the three log houses nestling among the cottonwood trees on Big Dry Creek were first pointed out as Jordan, for the place did not appear at all worthy of its celebration.

From Jordan the country is rolling part of the way, but suddenly as we crossed the divide near Hell Creek a panorama of striking beauty spread out before us. The whole country for 100 miles up and down the river is cut into fantastic "bad lands." Cañons 200 feet deep with nearly vertical slides and short lateral "culs-de-sac" make travel by horse difficult and sometimes almost impossible.

The somberness of these denuded areas is relieved by bright-colored, banded clays, different layers of which can often be traced for miles on the same level. Scattered pine trees cover most of the hills, while the sheltered hillside pockets are filled with junipers. In the valleys the courses of the streams are marked by fringing cottonwoods.

It was near the old Max Sieber ranch that the first bones were discovered, so it was thither that we directed our course. This is near the head of Hell Creek Cañon, where the stream has cut through yellow sepia-colored clays. Hard spherical-shaped sandstones of various sizes are scattered through these layers, and it is in the hard sandstones that bones are best preserved. Often the hillsides are strewn with clusters of immense rounded stones resembling a nest of eggs.

We camped on Hell Creek near the Sieber ranch and before the cook's call for dinner had located a specimen that proved to be one of the *Tyrannosaurus* skeletons. High up on a hill were numbers of large rounded sandstones; some had tumbled down the hillside and several contained bones. Tracing these scattered fragments up the side of the hill we at last found some running into the sand. Here were the bones in position where they had originally been covered before turning to stone. Nearly every bone in this specimen was encased separately in a flinty blue sandstone as hard as granite.

At first the sand was soft, but as we excavated beyond the frost line it was firmly cemented and so hard that a pick made but slight impression on it. As the bones were scattered and the hillside steep the undertaking became a herculean task with the means at hand. But it was recognized that the bones were those of an unknown creature, so additional help was secured and with plows and scrapers we attacked the hill. Soon, however, the sand became too hard to plow and then it was necessary to blast with dynamite. Each cut was carried down nearly to the bone layer and the bones were taken out separately. In this specimen there were several large blocks; one containing the pelvis weighed 4,150 pounds, and when crated could be handled only with tackle. It took 6 horses to move this block 12 miles out to the main road and 4 horses to transport it to the railroad.

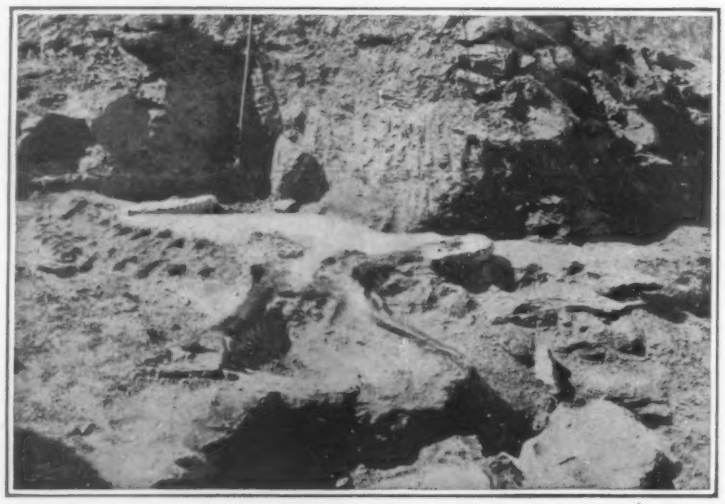
Part of a second season was also spent in recovering the bones of this animal, and when the excavation was finally completed a hole in the hillside had been made 30 feet long, 20 feet wide and 25 feet deep.

Six years later, in 1908, after almost continuous work in the Montana "bad lands," another more complete *Tyrannosaurus* skeleton was found on the Big Dry Creek. This is the skeleton just mounted.

Tyrannosaurus was a powerful creature, active and swift of movement when occasion arose. Its anatomical characters show distant relationship with lizards, crocodiles and birds. Like those of birds, the bones are hollow and the hind limbs in contour and construction closely resemble those of birds.

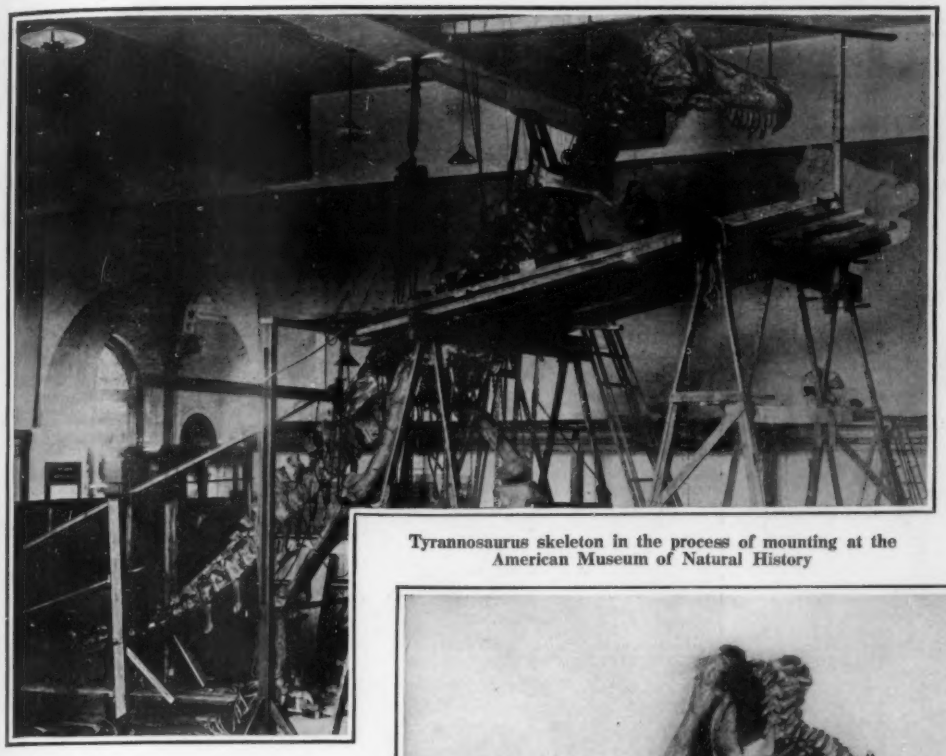
Long, powerful hind legs carried the body upright, balanced by a long tail, and the front limbs, no longer a means of locomotion, had become rudimentary and restricted for use only in grasping and holding. The massive head was armed with 13 dagger-like sawbladed teeth in each jaw, the largest 5 inches long.

Excavating Tyrannosaurus skeleton No. 973 at Hell Creek, Montana. Most of the bones of this skeleton were separately encased in flinty, hard sandstone



Tyrannosaurus skeleton No. 5027 uncovered. This skeleton, which has since been mounted, was found on Big Dry Creek

Skull and jaws of the skeleton. Lines of water stratification may be seen in the sandstone bank



Tyrannosaurus skeleton in the process of mounting at the American Museum of Natural History

As soon as one of these broke off, or wore out, another grew up from below, thus creating a never-ending supply.

The *Tyrannosaurus* was capable of destroying any of the contemporary creatures and was easily king of the period and monarch of its race.

Starting an Automobile by Wireless Waves

FOR the first time in the history of the automobile, it has been demonstrated that a car can be started from a distance by wireless wave control. The demonstration occurred at the Indiana State Fair, where the engine of an automobile was started every five minutes by wireless waves sent out from a station in Indianapolis, five miles away.

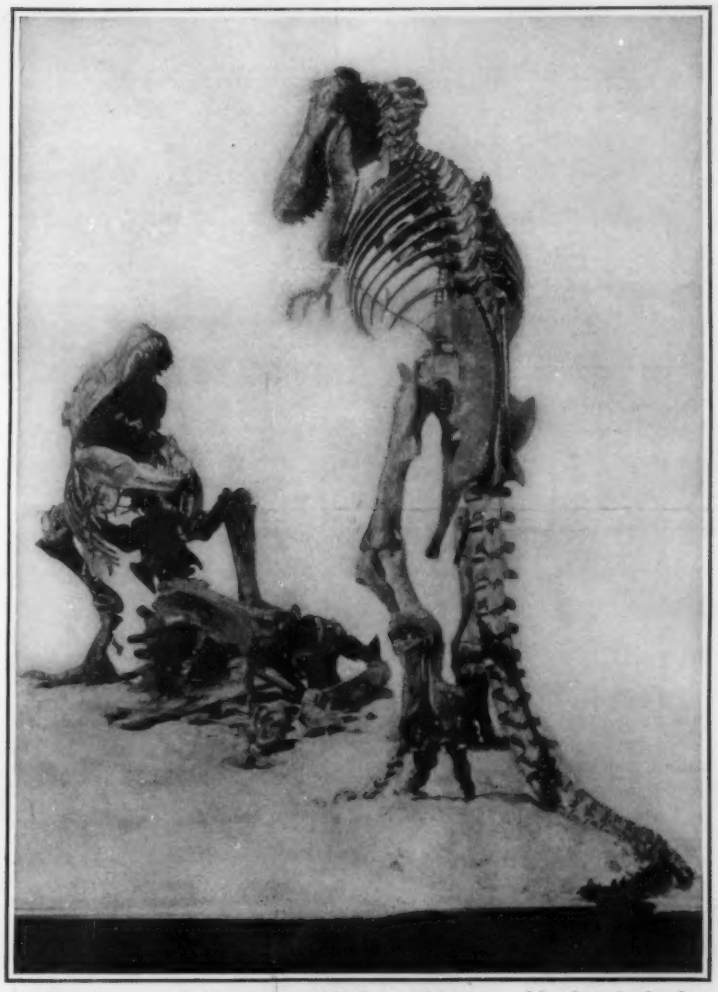
The complete wireless transmitting equipment consisted of a motor-generator, transformer, condenser and the necessary tuning apparatus, all of which were installed in a show window of a local automobile dealer. The transmitting set was connected with an aerial erected on the roof of the building.

The automobile on exhibition at the fair grounds was equipped with a receiving apparatus and the necessary relays and automatic switches for throwing on and off the electric current of the self-starter and magneto. An automatic switch was provided so as to allow the car to run for forty-five seconds, after which the magneto was cut off, bringing the car to a stop. As before stated, the operation of starting the car was repeated at five-minute intervals.

One of the most interesting features of the experiment was the fact that the entire operation of starting the car was accomplished without the aid of a human hand; a time switch, installed in connection with the wireless transmitter in the city, controlling the entire operation. From the time Gov. Ralston of Indiana placed the car in operation for the first time by pressing a key at the transmitting station, until the last day of the fair, the starting and stopping of the car was accomplished automatically.

Smokeless Powder from Wood Cellulose

COTTON is the material generally used in making powder which generates little or no smoke in combustion, a fact which sufficiently explains its being held as contraband of war. But we learn from a late number of *Naturwissenschaften* (Berlin) that Prof. C. G. Schwalbe and A. Schrimpf, investigators in the Experimental Station for the Study of Cell-substance and the Chemistry of Wood, make the statement that it is now possible to make nitrocellulose out of various sorts of commercial celluloses (wood celluloses), which answer the requirements of the authorities in having no impurities which exert a permanent influence on the stability of the finished product. The announcement is of importance even in times of peace, because of the greater cheapness of wood cellulose.



Two Tyrannosaurus skeletons mounted in the positions assumed by the animals when they engaged in combat

Effect of Ultra-Violet Rays on the Eye

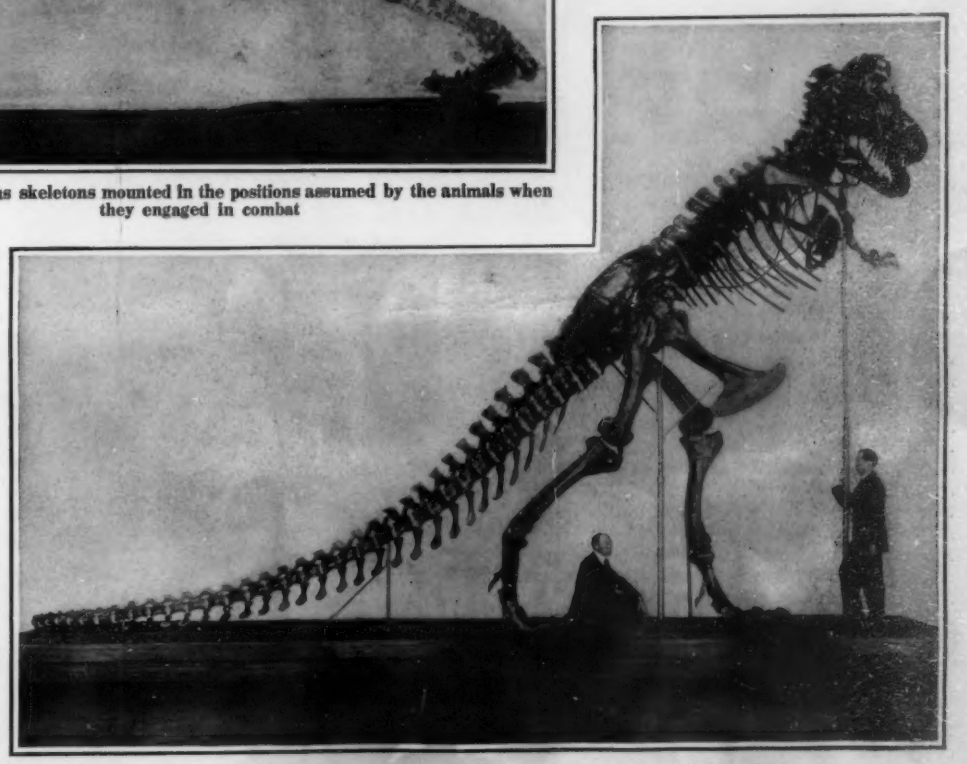
THE peculiar luminosity of the eyes of animals at night has long been an object of interest, and there are countless allusions to it in the literature of ages. It is very recently, however, that attempts have been made to find a scientific explanation for the phenomenon.

In June, 1913, Prof. Bugnion of the Vandois Society of Natural Science, advanced the following hypothesis as an explanation: "May we not suppose that certain obscure rays are transformed, by the effect of a chemical action, into visible rays at the instant of reflection from the depths of the eye? It is a fact that the eyes of nocturnal animals—mammals, birds, insects,—exhibit a very beautiful luminosity in certain circumstances, although the lamp which illuminates them may appear to be shining very feebly."

The *Revue Scientifique* (Paris), of August 7th, quotes these words and adds a description of the very curious experiments as to the effect of ultra-violet rays on human and animal eyes made by two Costa Rican professors, Mr. G. Michaud and Mr. J. F. Tristan. In a perfectly dark room a beam of sunlight was allowed to enter after being filtered by the so-called Uviol filter invented by Zeiss. This is composed of a cell of Uviol glass containing a solution of copper sulphate and a pellile colored by nitroso dimethyl aniline.

When the sheaf of ultra-violet rays thus obtained was allowed to fall upon the eye of an animal in the dark room, a startling effect was produced. The pupil of the eye was sharply defined in luminous green against the violet-black background of the iris. This was observed in human beings as well as in dogs. "This curious appearance of the eye is probably due to the fluorescence of one of the external *media* of the eye, perhaps the purple of the retina, and also to a very high degree of absorption of the ultra-violet rays by the iris, whose pigment in this case plays the same protective rôle as that of the pigment of the skin." The same observers have already demonstrated that if a white man, a negro, and an Indian be photographed with an objective of silvered glass, there is no appreciable difference in the white, black and red skins in the degree of absorption of the ultra-violet rays comprised between 3,160 W A and 3,260 W A, the white skin looking as black as the red and black skins.

In performing the experiment referred to above the "eyes like green carbuncles," it is necessary to remain in the dark room for 15 minutes previously.



Skeleton of Tyrannosaurus Rex No. 5027, 47 feet long and 18½ feet high

A big rock slide on the Lexington Avenue Subway

Method of blocking up the work after the slide

Not Merely Mining but Bridge Building

The Importance of Diagonal Bracing in Subway Timbering

OUR article on the collapse of the subway work in Seventh Avenue, in last week's issue of the SCIENTIFIC AMERICAN, was on the press when another similar cave-in occurred at Broadway and 38th Street. In the latter case it was not a blast of dynamite that tumbled down the timbering, but the force of gravity that projected a large mass of rock against the supporting columns. The same contractors were building this section of the subway; the same system of supporting the street was in use. As in the 7th Ave. accident the timbering started to fall one bent after another like a pack of cards, but a fortunate circumstance prevented the catastrophe from spreading over a great extent. Close to where the rock slide occurred it chanced that a number of uprights had been enclosed to form a bin through which material was passed to a lower level. This furnished a staunch buttress that stemmed the tide of falling bents and arrested further destruction; but for this check no doubt the havoc would have spread to the limit of the timber construction, involving an enormous loss of life.

The uncertain character of the rock of Manhattan Island was commented upon in last week's issue of the SCIENTIFIC AMERICAN. It is a danger that constantly menaces the work, but the menace being recognized, it should never catch the engineer unawares. If in spite of every precaution a slide does occur, now and then, the timbering should be so designed that the street will not be in danger or, at worst, so that any damage that may occur will be localized.

Figure 1 shows the type of timbering used where the accidents occurred. As shown by broken lines, the structure at the heading is carried upon 30-inch girders 42 feet long, which are supported at one end upon the rock, while at the other they rest upon timber towers (also shown by dotted lines). We commented in last week's issue upon the fact that no provision was made to take care of longitudinal stresses. While there was no stinting of timber, the heavy beams were not disposed to the best advantage. It will be observed, by referring to Figure 1, that diagonal braces to stiffen the bents and hold them in vertical position, are conspicuously absent. Apparently the engineers did not realize that this work is more than mere mining. It is really a combination of mining and bridge building, for the streets are carried on a timber trestle under which the mining operations are pursued. Being enclosed on all sides by rock and earth no provisions were made for any but vertical loads. The construction reminds us of the trestles built in the early days of railroad work, when dependence was placed on the inertia of the enormous mass of timbering to prevent swaying. Not until several serious accidents resulted and entire trestles collapsed, did the engineers realize the necessity of diagonal bracing.

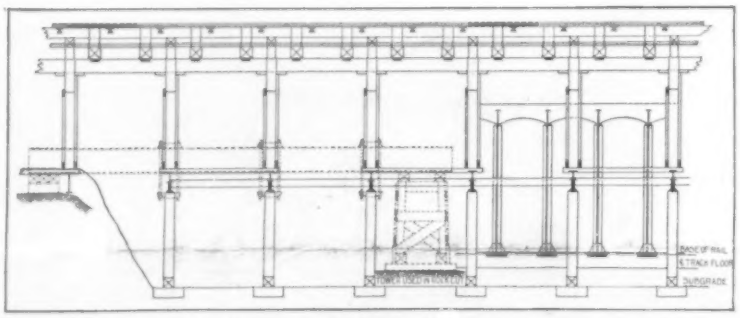


Fig 1. Type of timbering that collapsed

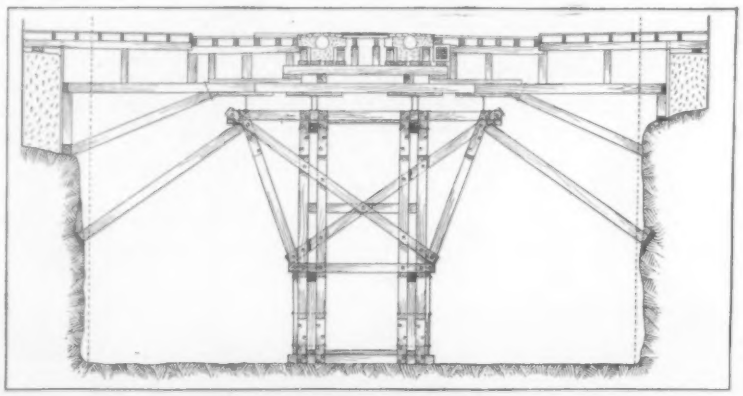


Fig 2. Tower system of timbering

A central tower supporting the street decking

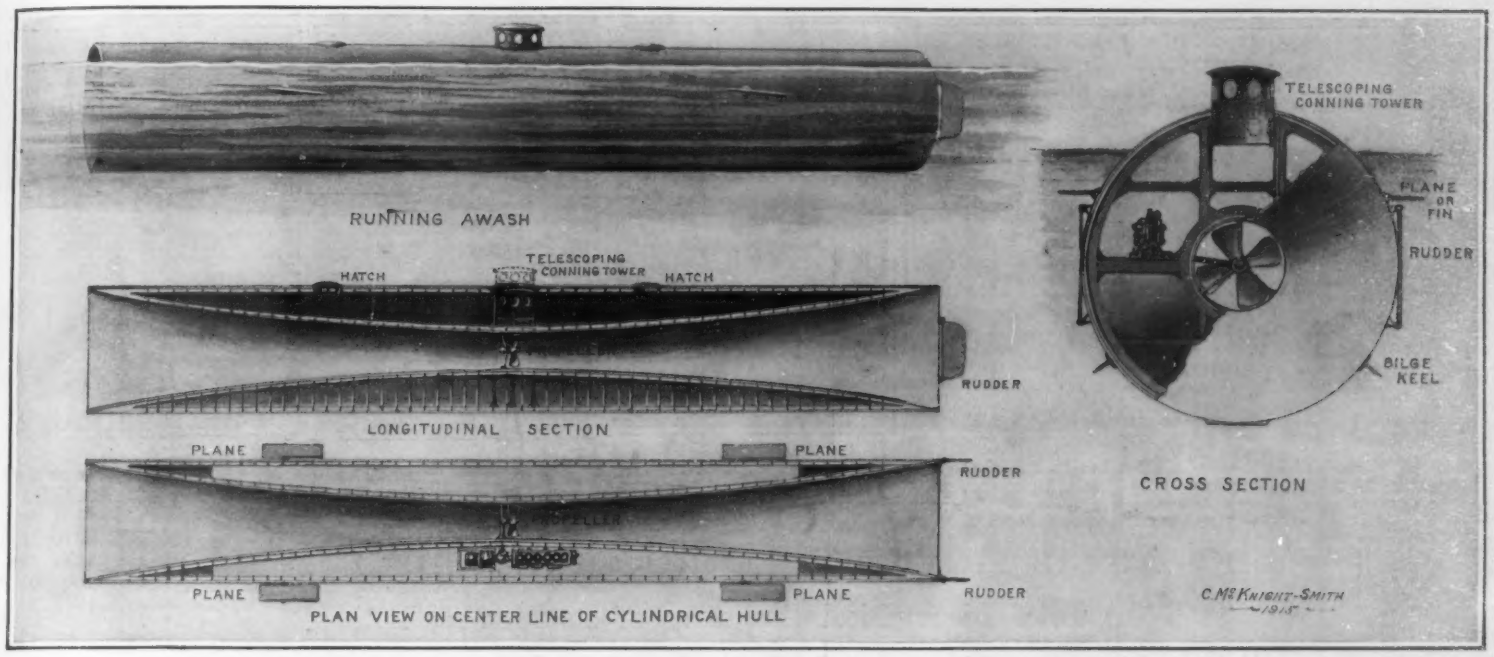
It seems that the same process of education is now going on in respect to the support of street decking, and it is to be hoped that the lesson will be learned before there is a more serious loss of life.

It must not be assumed that defective timbering is to be found throughout the subway work. There are many sections in which adequate bracing is employed. One notable section is that on the northern end of Lexington Ave., where a system of support is used that differs materially from that ordinarily employed. A cross section of this work is shown in Figure 2. Under the middle of the street and particularly under the car tracks continuous girders are provided which are supported on towers 12 feet square. These towers are braced in all directions and also against the sides of the excavation. The girders are strongly riveted one to the other and braced to form a truss which will carry the load of the street even with one or two of the towers knocked out from under it.

The work here is particularly difficult because of the treacherous nature of the rock. The material is excavated throughout the width of the street to the building lines and in places is 65 feet deep. Occasionally a large piece of rock has broken away from the side walls and crashed into the excavation.

Although there were many slides of serious proportions, the towers, being placed in the center of the excavation, usually were unharmed. Occasionally a tower was seriously damaged and yet the street overhead was not affected. The work here was carried on in two levels and when the lower level was excavated, a tower was frequently undermined and for a short time left actually hanging from the girders overhead.

The record of the work on this section would seem to indicate that subways can be excavated through the heart of Manhattan in the worst kind of rock without endangering traffic overhead.



Our artist's conception of the appearance, and constructional details, of a craft that would not displace water while in motion

Boat Design that Eliminates Bow Waves and Wake

By Carl Hering

THE well-known law of a floating body is that it displaces an amount of water equal in weight to the weight of the body. Hence the bow of a moving, floating body, like a boat, must push aside an amount of water just equal to its weight, and at the stern this amount of water must again flow into the space vacated by the boat; the propelling force of the boat must therefore exercise a pressure against the water in front of it and must also overcome suction behind it. These two forces produce the waves and wake which always accompany a moving boat.

If this displacement of the water by a moving boat could be avoided, then the force necessary for propulsion would be reduced by the amount spent in first moving aside and then sucking back the water displaced; resulting in the boat moving through the water without producing the usual waves.

At first sight it would seem paradoxical to claim that a body of appreciable volume could be moved through water without displacing it, yet the following will show that it is possible and might perhaps even be practicable under certain conditions.

To consider it in its simplest form, let the accompanying drawing represent a submarine vessel. The outside, *C*, is a shell in the form of a cylinder open at both ends. Let the inside surface be shaped about as shown, forming a hole through the cylinder, axially, which is enlarged to the diameter of the cylinder at the two ends, but tapers to a much smaller diameter at the middle. Let these two surfaces be made of a thin material, leaving the space, *S*, between them; this space forming the available space of the boat.

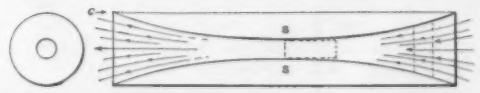
Let the propelling machinery force the water axially through this central hole, sucking it in at the front end and expelling it at the rear end. This may be done in any one of many different ways, as, for instance, by a propeller, rotary pump, or injector.

The speed of the water moving through this hole, relatively to the water on the outside, is greatest at the middle, changing gradually to zero (theoretically) at the two ends. The cross section of the column of water at any point must therefore be inversely as the speed at that point, hence this cross section must diminish from the two ends toward the middle. A space, *S*, will therefore be left between the inside and outside shells, but, though under water, this space will not have displaced any water while the boat is moving, as it then merely occupies the vacancy left between the moving column of water and the water on the outside.

Such a boat will therefore move through the water without displacing any of it, and accordingly will not have to overcome pressure in front or suction behind. Neither will the boat produce any waves, as it will cut through the water like an infinitely thin, cylindrical, hollow shell.

One of the staff artists of SCIENTIFIC AMERICAN has drawn what he conceives as the probable appearance of a craft utilizing the principle discussed, as well as a suggested plan for the arrangement of the driving machinery.

While at rest, a boat of this kind would of course displace water and float, providing that the space, *S*, were large enough. But when in motion at its normal speed it would sink, as there is then no displacement. Accordingly, it would either have to be provided with inclined planes at the side, be made wedge-shaped, or be provided with floats which then would displace some water.



Sectional view of a body which will not displace water when in motion

Three-wheeled automobile with the wheels arranged in staggered order

Analytical balance in which the weighing is accomplished by means of a fine platinum or gold chain

Another practical difficulty is that to obtain a relatively large space, *S*, to serve as carrying capacity, the velocity of the water, at the constricted part of the propelling column, would have to be impracticably great. Hence, even though the means of propelling is no doubt far better than the methods used at present, and even though the power for displacing water is saved, such a boat is of interest probably more as a curiosity than as a practical device. It is another illustration showing how unsafe it often is to say that a thing is impossible, simply because it has never been done before. It also shows how careful one must be in framing "universal" laws of nature.

Three-Wheeled Automobile of Unusual Design

ONE of the latest and most unusual attempts to produce a three-wheeled automobile is that of C. Clarence Holden, of Dallas, Tex. Instead of adopting the usual plan of placing the third wheel equi-distant from the other two, this inventor has placed the wheel directly in front of the left rear wheel. A hasty glance at the car would convey the impression that it is a four-wheeled machine that has lost its right front wheel.

The right rear wheel of this novel automobile is not connected with the left rear wheel, and is simply an idler. It is even placed a trifle forward of the left wheel, so that lines drawn from wheel to wheel would form a scalepe triangle. Merit is claimed for this positioning of the wheels on the ground that no two wheels strike obstructions at the same time. On the road the arrangement is said to result in a peculiar fore and aft rocking motion.

The drive is through the left rear wheel only, and consequently the driving system is greatly simplified. This and the saving due to the use of one less tire are the chief advantages claimed for the machine. It seems probable, however, that the saving of the fourth tire will be more than made up by excessive wear of the one front tire, the tread of which should be worn away rapidly by the sideways grinding against the road, to which it will be subjected by the drag of the right idler wheel.

A Direct Reading Analytical Balance

NOTHING could be simpler than a little chain fitted to a delicate analytical balance and serving the purpose of the conventional milligram weights and beam riders. Yet this small chain promises to revolutionize the design of delicate balances and the method of manipulating them, since it not only gives direct readings in milligrams on a graduated scale, but, it is claimed, the time for the weighing operation is reduced to one quarter of that usually required. For several decades and even until the present day the time-consuming, tedious and liable-to-error method of small weights and beam riders has been generally used for want of a better one.

The present innovation in analytical or delicate balances is due to the efforts of Christian Becker of New York. Briefly, the weighing is accomplished by a small platinum or gold chain suspended at one end from an adjustable screw fitted to the beam of the balance, and

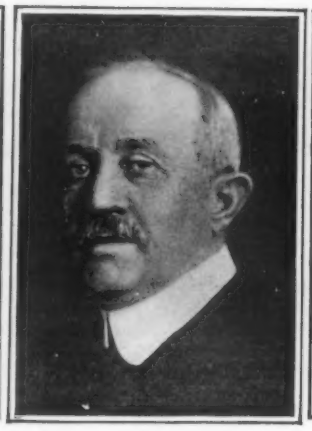
(*Concluded on page* 327)

Prof. W. R. Whitney
Am. Chemical Society.

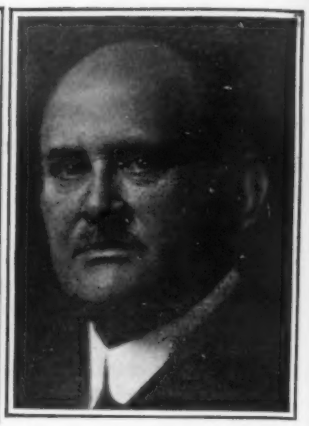
Photo by Falk

Dr. Leo H. Baekeland
Am. Chemical Society.

Benj. G. Lamme
Am. Inst. of Electrical Engineers.



Lawrence Saunders
Am. Inst. of Mining Engineers.



Benj. B. Thayer
Am. Inst. of Mining Engineers.

The Naval Advisory Board of Inventions—II

A Brief Biographical Summary of Its Membership

IN continuing the biographical notes of the membership of the Naval Advisory Board of inventors, it is gratifying to learn that there will be no delay in its taking up the duties intrusted to it, and that meetings for that purpose have already been arranged.

The American Society of Mechanical Engineers is represented by William Le Roy Emmett, of Schenectady, and Spencer Miller, of South Orange, N. J. Mr. Emmett was born at Pelham, N. Y., in 1859, and is a graduate of the U. S. Naval Academy. He received the honorary degree of Doctor of Science from Union College, and has made a specialty of electrical engineering. He is now connected with the lighting department of the General Electric Co., but has given considerable attention to general engineering, and is the inventor, among other things, of a vertical shaft steam turbine. Mr. Miller is chief engineer of the cableway department of the Lidgerwood Mfg. Co. He was born in Waukegan, Ill., and received the degree of B.S. from the Worcester Polytechnic, where he received his engineering education. He has made inventions relating to apparatus for saving life at sea and cableways for coaling vessels at sea which are used by the Navy Department.

The American Institute of Electrical Engineers furnished Frank Julian Sprague, of New York, and Benjamin G. Lamme, of Pittsburgh. Mr. Sprague was a pioneer in electric railway transportation and in high speed electric elevators; he has made many inventions in electric motors, both for trolley cars and stationary work, as well as in power transmission and electric railway systems. He was born at Milford, Conn., in 1857, and is a graduate of the U. S. Naval Academy. From his graduation from the Academy in 1878 until 1884 he was an officer in the navy, when he went with Edison as an assistant. He has been consulting engineer to the Edison General Electric Co., The General Electric Co., and a member of the Terminal Commission for the Electrification of the New York Central Railway, and has been at the head of several manufacturing companies in electrical lines. He has received several medals in recognition of his inventions, and is engaged in the profession of electrical engineering. Mr. Lamme was born on a farm near Springfield, Ohio, and graduated as a mechanical engineer from the Ohio State University. Entering the employ of the Westinghouse Electric Mfg. Co. he took up designing, in which line he has been particularly distinguished. He became assistant chief engineer, and later chief engineer of the company, which position he now holds. He has been a leader in the development of alternating current electrical machinery, and one of the notable installations with which he has been identified is the famous 5,000 horse-power generators at Niagara Falls which were many times larger than any before built, and containing radical departures from the then standard designs. He was also connected with the motor and generator equipment of the New York, New Haven and Hartford Railroad, the Paoli electrification of the Pennsylvania Railroad, and many other important installations. As an inventor he has a large number of important patents to his credit, and as an engineer he is particularly interested in the training of young engineers, and takes particular pleasure in discovering and assisting young men of ability along the lines in which he has been successful. One of his present duties is as chairman of a committee of the Westinghouse Electric Mfg. Co., which passes on the merits of various inventions that are brought to the attention of the company.

Hudson Maxim
Am. Aeronautical Society.

Frank J. Sprague
Am. Inst. Electrical Engineers.

The American Aeronautical Society nominated to the Board Hudson Maxim, of Brooklyn, and Matthew Bacon Sellers, of Baltimore. Hudson Maxim is one of the most prominent inventors and experimenters with high explosives in the world, and besides being most active in many other directions, is well known as a writer, critic, philosopher and sociologist. He was born in Orneville, Me., and in early life was engaged in the publishing business, which he abandoned for the wider field of inventing and experimenting. He developed and manufactured the first smokeless powder that was used by the United States Government, but later sold his invention to the Dupont Powder Co., of which he became the consulting engineer and expert in experimental work. He has produced a number of high explosives and similar materials, and a process for the continuous production of calcium carbide is also one of his inventions. Of late he has taken great interest in aeronautical matters.

Mr. Sellers was born in Baltimore, where he received his education. He graduated from the Law School of Harvard University, and took special courses in the Laurence Scientific School and the Drexel Institute. He also spent a year each at the Gymnasium at Gottingen and at Evreux, France, in advanced study. He is the technical editor of *Aeronautics*, and a member and past chairman of the technical board of the Aero Society of America. He is also a member of the Aerodynamic Commission of the Aero Club of America. Mr. Sellers has prosecuted investigations for determining air pressure on arched surfaces, and is the inventor of a stepped aeroplane that is the lightest machine so far built.

The American Institute of Mining Engineers is represented by William Lawrence Saunders and Benjamin Bowditch Thayer, both of New York. Mr. Saunders is a mining engineer of prominence, and was born in Columbus, Ga., in 1856. He is a graduate of the University of Pennsylvania, and for a time was in charge of the hydrographic work of the National Storage Co.

(*Concluded on page* 327)

Wm. L. Emmett
Am. Soc. of Mechanical Engineers.

Spencer Miller
Am. Soc. of Mechanical Engineers.

Matthew B. Sellers
Am. Aeronautical Society.

Prof. Joseph W. Richards
Am. Electro-Chemical Society.

Lawrence Addicks
Am. Electro-Chemical Society.

A Direct Reading Analytical Balance

(*Concluded from page 325.*)

at the other, to a hook held by a sliding block. The latter may be moved vertically on a flat rod that is graduated in milligrams. The block, which is marked as a vernier for obtaining readings to one tenth milligram, is moved along its supporting rod by a vertical spiral drive in the rear, which in turn is rotated by a thumb screw through bevel gears.

To operate the new balance it is only necessary to rotate in either direction the thumb screw controlling the block, so as to cause the leg of the chain hanging from the beam to be lengthened or shortened, adding more or less weight until balance obtains. The window of the balance is closed after the object to be weighed has been placed on the pan, and is left closed during the entire weighing operation. The altering of the chain weight can take place while the beam is swinging, so that neither the pans nor the beam need be rested at any time during the weighing operation, resulting in a great saving in time. The direct readings taken from the graduated scale and the vernier also constitute a time and labor saving feature, and will reduce errors to a minimum as compared to the conventional method which requires the careful reading and adding of the denominations marked on the diminutive weights, as well as that of the beam rider. Increased accuracy is also secured by the gathering of the least amount of moisture by the article weighed. The range of the chain weight is considerable; in one of the most popular of these analytical balances it will weigh from one tenth milligram to 50 milligrams. By using a lighter or heavier chain, the graduated scale can be calibrated for finer or coarser weighing.

To anyone familiar with the ordinary analytical or jeweller's balances the advantages of the new chain balance are quite obvious, since it renders the weighing of minute quantities hardly more difficult than the weighing of larger quantities on small, commercial scales. Professors of chemistry in several leading universities, as well as analytical chemists and heads of industrial laboratories, have tested the chain balance and pronounced it a great improvement over existing types.

The Naval Advisory Board of Inventions—II

(*Concluded from page 326.*)

He is President of the Ingersoll-Sargeant Drill Co., the Imperial Tool Co., and the Ingersoll-Rand Co., and has been the editor of *Compressed Air Magazine.* He is also connected with other companies interested in the manufacture of pneumatic apparatus. His specialty is compressed air machinery, and he is an inventor in this line. Mr. Thayer was born in San Francisco, and is a graduate of Harvard University. He is prominent as a mining engineer, and is President of the American Institute of Mining Engineers. He is President of the Anaconda Mining Co.

The American Chemical Society nominated Dr. Leo H. Baekeland, of Yonkers, N. Y., and Prof. W. R. Whitney, of Schenectady, N. Y. Dr. Baekeland is widely known as a chemist and as the author of a number of inventions of a chemical nature. He was born at Ghent, Belgium, in 1863, and is a graduate of the University of Ghent, where he was later Assistant Professor and Associate Professor of Chemistry. He also held a chair as Professor of Chemistry and Physics at the higher Normal School at Bruges. In the various chemical associations in America, Dr. Baekeland has taken a prominent position both as a member and in official capacities. He is most prominently known to the public as the inventor of Velox gaslight paper for photographic prints and Bakelite, a substance widely used as an insulator in electrical apparatus, and which is also employed for a great number of technical purposes. His researches in technical chemistry have been very extensive, and he is considered a leader in this branch of science. Prof. Whitney was born at Jamestown, N. Y., in 1868, and graduated from the Massachusetts Institute of Technology, where he sub-

sequently served as Instructor, Assistant Professor and Professor of Chemistry. He is now director of the great research laboratory of the General Electric Co., where his influence in many directions of improvement has been most potent; and many people know that research work involves very considerable inventive ability.

The representatives of the American Electro Chemical Society contributed Prof. Joseph William Richards, of South Bethlehem, Pa., and Lawrence Addicks, of Chrome, N. J. Prof. Richards, who holds the chair of metallurgy and mineralogy at Lehigh University, was born in Oldbury, England, in 1864, and received his education in the public schools of Philadelphia. He received degrees from Lehigh, and spent considerable time in advanced study in Heidelberg. He spent some time as assistant superintendent of the Delaware Metal Refinery, at Philadelphia, and was a member of the Assay Commission to test Coinage in 1897. He has conducted many investigations of the chemical and physical properties of metals, and metallurgical operations. Lawrence Addicks is an authority on the metallurgy of copper, and is the superintendent of the plant of the U. S. Metals Refining Company, at Chrome, N. J. He was born in Philadelphia, in 1878, and graduated from the Massachusetts Institute of Technology with the degree of Bachelor of Science in mechanical and electrical engineering. He has held important positions as consulting engineer and is well known in his special fields on matters relating to metallurgy.

Strategic Moves of the War,

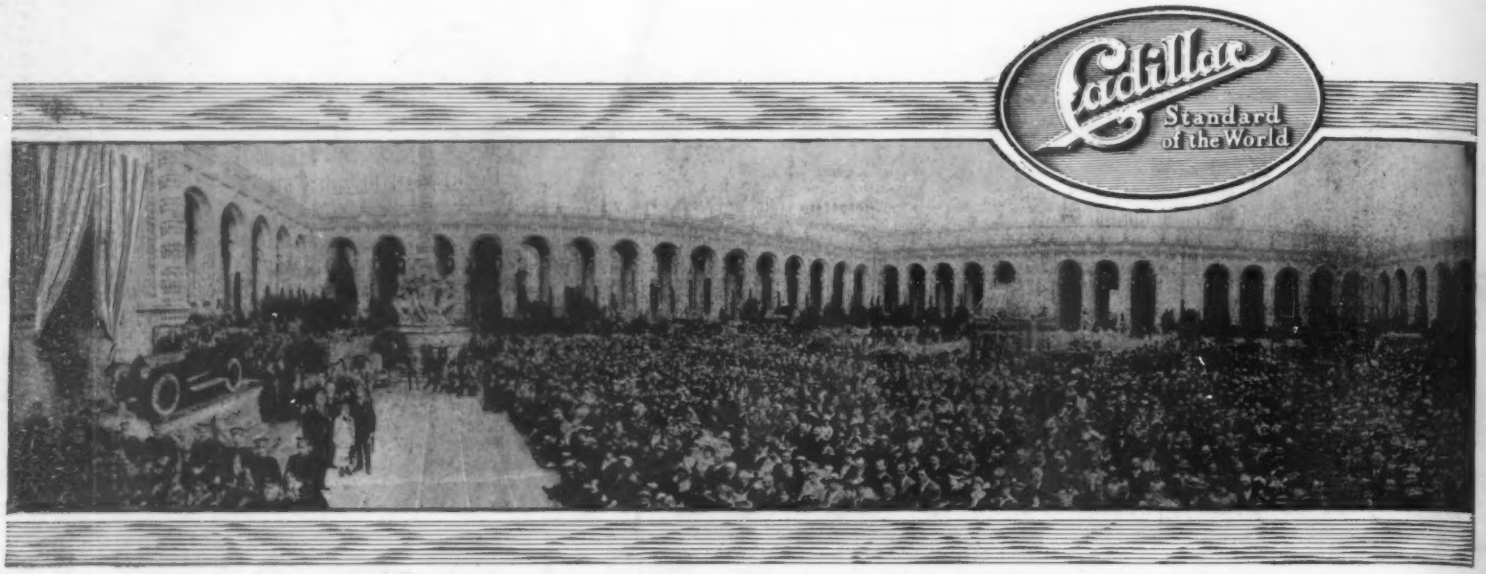
(*Concluded from page* 320)

cate no anxiety in Germany for the safety of the German armies in France, and express confidence that their lines will check any further Allied advance. Such reports are to be expected, but when taken in connection with the undiminished fighting in Russia, and the continued activity of the Teutons on the Serbian frontier, they acquire increased importance and seem to make imperative a continuance of the Allies' offensive in the west if any real and lasting benefit is to be secured from it.

Before the tide of victory will turn from the Germans and run strong for the Allies, the initiative so long held by the Germans must be wrested from them and taken over by the Allies. Ever since the beginning of the Russian campaign in the first days of May, the Teutons have laid down the law on practically every battle field of major importance, and with every new success they have grown bolder in the conception and execution of their plans. Their initiative has gained momentum with success, and it will be no easy task to strip them of it so completely that they will be playing to the lead of the Allies east, west and south. To do this the Allies must be ready to carry through in the west the same character of campaign as the Germans have waged against the Russians for five months in the east. Whether they have the supplies for such a campaign, are willing to make the terrible sacrifice of life that will be necessary, and have selected this occasion for the great offensive, the developments of the next few weeks will show. On the other hand if they are content with the single successful thrust they have made at the German lines, we may expect to see the German offensive in the east continue unabated, and the smouldering volcano in the Balkans break into active eruption.

Evaporation in the United States

The Weather Bureau has recently undertaken a campaign for the determination, under standard conditions of exposure, the relative values of evaporation in various parts of the United States, and, if possible, the relation of these values to other climatic factors. It is planned to equip about thirty stations with instruments of identical pattern. The Bureau is also preparing to publish the results of its previous elaborate observations of evaporation, at Salton Sea and elsewhere.



CADILLAC DAY AT THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION, SAN FRANCISCO, AUG. 20, 1915.

A SIGNAL HONOR, the first time ever conferred upon a motor car, reflected the esteem in which the Cadillac is held as an exponent of the highest American manufacturing ideals.

August 20th was designated as Cadillac Day by the officials of the Panama-Pacific International Exposition at San Francisco.

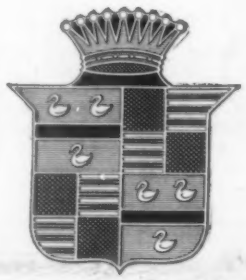
In the presence of an immense throng the new Type 53 Eight-Cylinder Cadillac was unveiled.

The climax of an elaborate and impressive ceremonial was the presentation of the Certificate of the MEDAL OF HONOR awarded to the Cadillac by the International Jury of Awards.

The presentation was made by Captain A. C. Baker, Director of Exhibits and was accepted for the Cadillac Company by Mr. Don Lee the Company's representative in California.

The Cadillac was the only motor car with a V-type Engine exhibited at the Exposition.

The tribute paid is unique in the annals of the industry.



THE COAT OF ARMS OF ANTOINE DE LA MOTHE CADILLAC WHO FOUNDED IN 1701, UNDER COMMISSION FROM LOUIS XIV, THE COLONY ON THE SITE WHERE NOW STANDS THE CITY OF DETROIT.

THE TYPE 53 CADILLAC CAR IS DISTINGUISHED BY THIS COAT OF ARMS MOUNTED UPON ITS RADIATOR.

Cadillac Motor Car Co. Detroit, Mich.